TCO_2M®

Transcutaneous CO_2/O_2 Monitor

User's Manual

Model 860

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1 Introduction

The *TCO_2M*® Transcutaneous CO_2/O_2 Monitor, Model 860 is designed to be an easy-to-operate stand-alone transcutaneous monitoring system. It is intended to be used in patient monitoring environments by technically skilled clinical personnel.

About this manual

This manual is written for clinical personnel using the *TCO_2M*® Transcutaneous CO_2/O_2 Monitor, Model 860, the Transcutaneous Calibrator, Model 868, and the transcutaneous sensors and accessories intended for use with the monitor and calibrator from Novametrix Medical Systems Inc.

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Indications for Use

The *TCO_2M* Transcutaneous CO_2/O_2 Monitor, Model 860 is indicated for use as a trend monitor for CO_2 and O_2 tension at the skin surface for neonates and adults as an adjunct to arterial CO_2 and O_2 blood gas measurements. This equipment is not a blood gas device.

Regulatory review (U.S.A.) of safety and effectiveness for transcutaneous oxygen monitors is not required at this time. However, the oxygen-monitoring portion of this device has been found to be substantially equivalent to devices marketed in interstate commerce prior to May 28, 1976.

Summary of features

The *TCO_2M* Transcutaneous CO_2/O_2 Monitor provides reliable, continuous measurement, displays and alerts for transcutaneous oxygen tension ($PtcO_2$), transcutaneous carbon dioxide tension ($PtcCO_2$) and sensor temperature. Sensor heater power is also trended and can be displayed. The monitor's real time graphic onscreen trends along with the numeric values provide truly continuous CO_2 and O_2 monitoring. A simple menu system with helpful messages guides the user through setup and alert conditions. Built-in 24-hour trend memory with graphic and histogram displays are available for viewing of patient history. The lightweight portable monitor can operate from AC power or from its internal battery. Sensor calibration is quick, fully automatic, barometric pressure compensated, and uses a true two-point method for accurate calibrations. The Calibrator is completely powered from the Monitor and the sensor can be inserted and removed from the calibrator with a single hand. *TCO_2M* accepts combination CO_2/O_2 sensors as well as CO_2 only or O_2 only sensors for optimum versatility. Sensors provide superior performance, fast response, are rugged, reliable and can be membraned in seconds. An automatic site timer enhances patient safety.

Principles of Operation

Oxygen

Transcutaneous oxygen is measured with an oxygen sensor consisting of two parts; 1) a modified Clark-type polarographic electrode, a silver anode and platinum cathode, electrolyte and an oxygen permeable membrane, and 2) a heating section with two precision thermistors for measuring and controlling the sensor temperature. When the sensor is subjected to oxygen, the oxygen molecules diffuse through the membrane and create an electro-chemical reaction which causes current to flow through the cathode. An amplifier connected to the cathode measures current flowing and converts it to a value proportional to the oxygen tension at the sensor/membrane interface. This is $PtcO_2$ and is displayed as a O2 value (in either mmHg or kPa as selected by the user).

Carbon Dioxide

Transcutaneous carbon dioxide is measured with a sensor that utilizes a unique pH electrode based on the Stow-Severinghaus principle. The carbon dioxide sensor is composed of two parts; 1) a carbon dioxide sensor consisting of a pH electrode, reference electrode, electrolyte and a carbon dioxide permeable membrane, and 2) a heating section with two precision thermistors for measuring and controlling the sensor temperature. When the sensor is subjected to carbon dioxide, the carbon dioxide molecules diffuse through the membrane and react with the electrolyte. This reaction alters the pH of the electrolyte solution, which in turn changes the voltage across the pH and reference sensors. Since carbon dioxide is the only gas that can affect the pH of the electrolyte, there is a direct correlation between pH and the amount of CO_2 present. This relationship is expressed by the Henderson-Hasselbach

equation:

$$pH = pKa + \log \frac{HCO_3}{0.03\ pCO_2}$$

An amplifier measures this voltage change and converts it to a value corresponding to the carbon dioxide tension at the sensor/membrane interface. This is $PtcCO_2$ and is displayed as a CO2 value (in either mmHg or kPa as selected by the user).

Local Power

Local Power is the measure of electrical power, measured in milli-watts (mW), required by the sensor to maintain the selected sensor temperature setting. The Local Power value is proportional to the blood flow beneath the sensor site. Because the sensor set temperature is above blood temperature, blood flowing past the sensor site provides a cooling action. As blood flow (and its associated cooling action) increases, the sensor requires more power to maintain its temperature setting and the LP value increases. Conversely, as blood flow decreases, sensor heater power and LP also decrease.

Abrupt changes in $PtcO_2$ coupled with significant LP changes may indicate reduced blood flow at the sensor site, while abrupt changes in $PtcO_2$ unaccompanied by significant LP changes may indicate consistent blood flow but a change in PaO_2.

Important: Sensor heater power requirements (LP) are also influenced by body temperature and ambient temperature changes. Body temperature changes tend to be gradual over time and produce minor changes in LP. Ambient temperature changes from air-conditioners, patient warmers, radiant heaters, etc., can have significant effects on the LP value. If monitoring the LP value, it may be necessary to insulate the sensor from ambient temperature changes with a light covering such as a bedsheet, or with material designed to reflect radiant heat energy.

Technical Description

Per requirements of IEC 601-1, *TCO_2M* is classified as class I equipment, internally powered, with type BF applied part, and IPX0.

The *TCO_2M* Transcutaneous CO_2/O_2 Monitor, Model 860, contains no user serviceable parts. Refer servicing to qualified service personnel.

See “Accessories” on page 99 for listings of the Service Manual and Service Test kit for use by technical personnel.

Transport and storage conditions: -10 to +55° C (14-131° F) < 90% relative humidity non-condensing. Operating conditions:10-40° C (50-104° F).

2 Safety

Patient Safety

- The location of the sensor on the patient should be changed periodically to minimize the risk of heat induced skin damage. The risk of such skin damage is dependent upon the sensor temperature, duration of application and physiological parameters including local perfusion, body temperature, and skin thickness.
- *TCO_2M* monitor has electrically isolated inputs. Patient leakage current flowing from the instrument to ground is limited to less than 10 µA at 120 V, 60 Hz. Patient isolation is greater than 10 MΩ, 2500 V rms at 60 Hz. For maximum patient and operator safety, the following procedures are recommended;
  - •Keep the *TCO_2M* and its accessories clean.
  - •Do not operate the *TCO_2M* when it is wet due to spills or condensation.
  - •Do not touch the patient while making adjustments on the *TCO_2M* monitor.
  - •Whenever possible, the *TCO_2M* monitor should be connected to the same circuit as other equipment in use on the same patient. Outlets that are on the same circuit can be identified by your hospital's engineering department.
- In areas where electromagnetic devices (i.e., electrocautery) are used, patient monitoring may be interrupted due to electromagnetic interference. Electomagnetic fields up to 3 V/m will not adversely affect system performance.
- The $PtcCO_2$ display reading (CO_2) is factory set to reflect the metabolic factor for pCO_2 and the value is corrected only during patient monitoring—not during calibration. See "PtcCO2 Display Values" on page 19.
- Components of this product and its accessories which have patient contact are latex free.
- Connect only Novametrix supplied transcutaneous sensors and gas calibrators to the *TCO_2M* Model 860 monitor front panel input connectors. Refer to "Accessories" on page 99 for listings and catalog numbers.

Contraindications

- In patients who are hemodynamically compromised, transcutaneous gas values may no longer reflect arterial gas values due to changes in blood flow to the tissue.
- Patients with extremely sensitive skin should be carefully evaluated prior to monitoring as sensor heat or adhesive ring application may cause skin irritation. Skin irritation due to the adhesive ring can be minimized by loosening the adhesive with alcohol or water prior to its removal from the patient.
- HALOTHANE INTERFERENCE. Halothane is the only known anesthetic gas affecting the reliability of transcutaneous oxygen ($PtcO_2$) measurement as demonstrated in in-vitro testing of the Transcutaneous Combination O_2/CO_2 Sensor (PN:4474). The affect of halothane on transcutaneous oxygen measurements in-vivo has not been determined. Halothane does not affect the transcutaneous carbon dioxide ($PtcCO_2$) measurement of the Transcutaneous Combination O_2/CO_2 Sensor. No known anesthetic gasses affect the performance of the Transcutaneous Oxygen Sensor (PN:6754) or the Transcutaneous Carbon Dioxide Sensor (PN:6752).
- $PtcO_2$ levels in excess of 150 mmHg may cause drift of $PtcCO_2$ portion of the 4474-00 Combination O_2/CO_2 Sensor using an 8900 Split Membrane NOVADISK®. This drift is not experienced with the 4474-39 Combination O_2/CO_2 Sensor and 8575 NOVADISK, nor with the Transcutaneous Oxygen Sensor (PN:6754) or the Transcutaneous Carbon Dioxide Sensor (PN:6752).

Warnings

WARNING: Indicates a potentially harmful condition that can lead to personal injury.

- **Explosion Hazard:** Do NOT use the *TCO_2M* in the presence of flammable anesthetics. Use of this instrument in such an environment may present an explosion hazard.
- **Electrical Shock Hazard:** Always turn the monitor off before cleaning it. Do NOT use a damaged sensor or one with exposed electrical contacts. Do NOT remove covers or panels. Refer servicing to qualified service personnel.
- **Failure of Operation:** If the monitor fails to respond as described, do not use it until the situation has been corrected by qualified personnel.
- **Fire Hazard:** The *TCO_2M* and its sensors should not be exposed to elevated oxygen levels *at* elevated pressures. Use of this instrument in such an environment may present a fire hazard.
- For installations where the integrity of the external protective earth conductor arrangement is in doubt, the equipment should be operated from its internal battery only.

- No user serviceable parts inside. Refer servicing to qualified service personnel.

Cautions

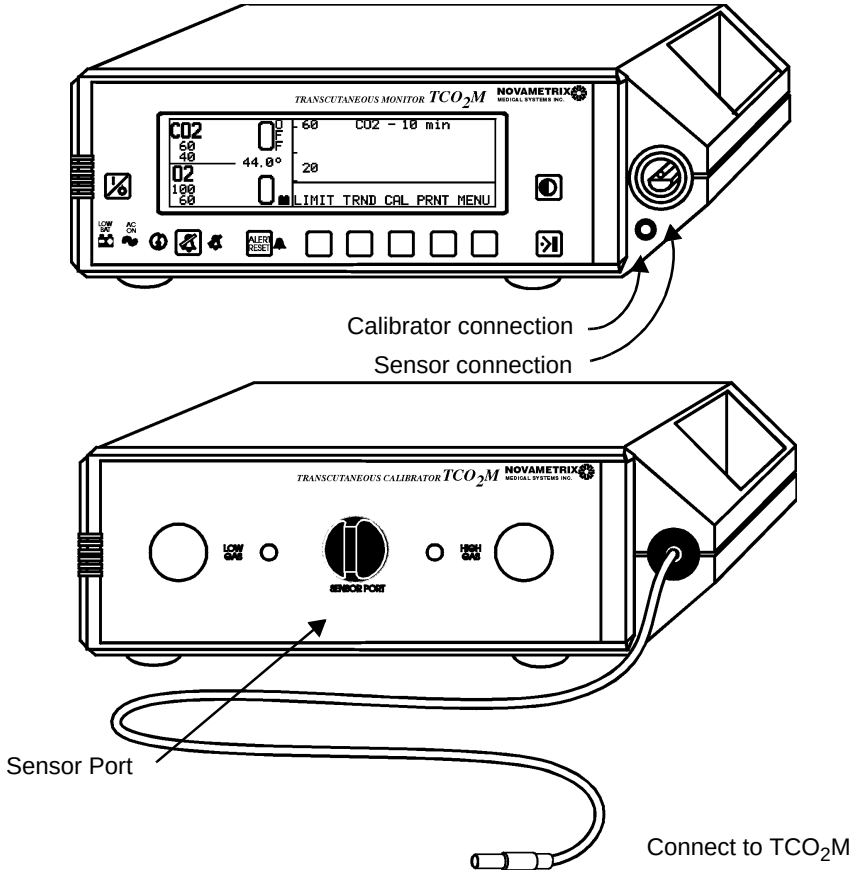
CAUTION: Indicates a condition that may lead to equipment damage or malfunction.

- Federal (U.S.A.) law restricts this device to sale, distribution, or use by or on the order of a licensed medical practitioner.
- No tension should be applied to the sensor cable.
- Avoid storing the monitor and sensors at temperatures less than -10° C or greater than +55° C (<14° F or >131° F).
- Do NOT immerse the monitor or sensors in liquids.
- Do NOT sterilize the monitor or the sensors.
- Electric Shock Hazard. Always turn the monitor off before cleaning it. Do NOT use a damaged sensor or one with exposed electrical contacts. Do NOT remove covers or panels. Refer servicing to qualified service personnel.
- Connect the line cord only to a grounded hospital-grade outlet.
- For continued protection against fire hazard, replace fuses only with those of the same type and rating.
- No user serviceable parts inside. Refer servicing to qualified service personnel.
- Operate at temperatures between +10° C to +40° C (50-104° F), < 90% relative humidity (non-condensing).

3 Quick Start Guide

This section summarizes and highlights the key steps and processes required to properly configure the *TCO$_2$M*® monitor for operation, connect and calibrate the sensor, apply the sensor to the patient, handle any associated alerts, and remove the sensor from the patient.

This section is an adjunct to other sections of this manual where these steps or processes are explained in more detail. Refer to the appropriate sections for more information. Use of equipment other than mentioned here may yield different results.



Connect Sensor

1 Attach an appropriate sensor to the *TCO$_2$M*'s front panel connector. The sensor will "click" into place when properly installed.

Ensure the sensor is in good physical condition and that the NOVADISK membrane assembly is intact and clean—use an alcohol wipe if needed.

Power Up

2 Press the ⏻ key to turn the *TCO₂M* on.

AC ON ∿ illuminates if the monitor is connected to the AC line and the rear panel power switch is set to "|". This also causes the internal battery to charge.

A battery icon appears on the display if the monitor is operating from its internal battery.

3 The base menu display appears after the power-up and self-test messages.

4 Press the ◐ (Contrast) key to adjust the display for optimum viewing.

Calibrator Setup

5 Connect the Model 868 Calibrator to the small connector on the monitor's front panel.

Ensure that the gas cylinders are properly installed. They are color coded to make it easy. Check that the cylinders are not empty. Both gauges should be registering pressure.

If using an O_2 only sensor, the Model 868 Calibrator is not required.

Calibration

6 Place the sensor into the Calibrator's Sensor Port.

If using an O_2 only sensor, refer to the appropriate section of the manual for calibration.

7 Press the **CAL** softkey. Verify the calibration settings, including site timer duration and temperature are correct. Press **START** to begin calibration.

If calibration settings need adjustment, press **SET** to adjust them.

Calibration will not begin if the sensor is not yet up to operating temperature. Wait until temperature is achieved and try calibration again.

8 When the *TCO₂M* beeps and the CALIBRATION DONE message appears, press **RUN** and remove the sensor from the calibrator.

Alert Limits

9 Verify the alert limits are properly set. If needed, press **LIMITS** to adjust.

Apply to Patient

10 Attach an adhesive ring to the sensor face, apply a drop of contact gel, and apply the sensor to a properly prepared site.

Handling Alerts

11 To temporarily silence an audible alert and to keep the red alert bar from flashing for two minutes, press the 🔔 key.

12 Once the parameter comes back within limits (or limits are widened), press **ALERT RESET** to clear the displayed message and flashing limit display.

Removal from Patient

13 To remove the sensor from the skin, gently peel the adhesive ring from the skin. Wiping the ring with water or alcohol will loosen the adhesive and aid removal.

Monitor Shutdown

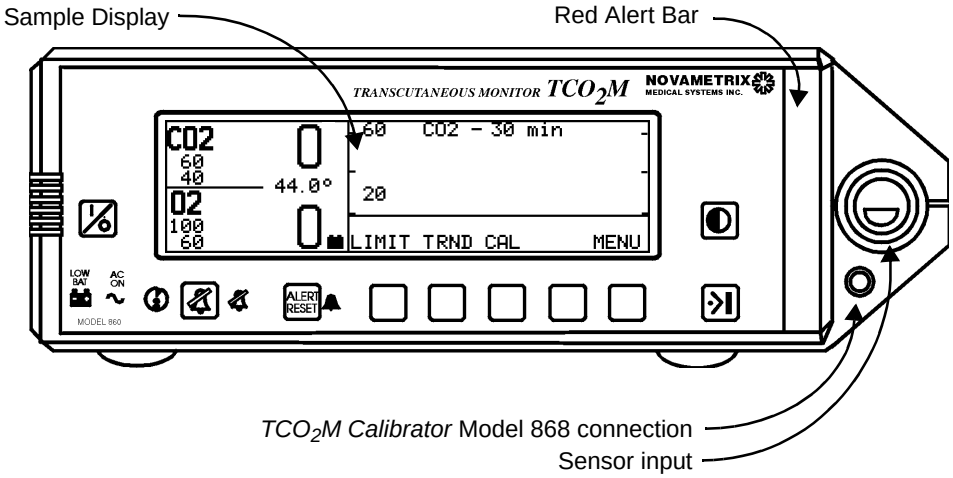
14 To turn the *TCO₂M* off, press the ⏻ key.

4 System Overview

This section provides an overview of the *TCO$_2$M* Transcutaneous Monitoring System including the Model 860 Monitor, Model 868 Calibrator, and transcutaneous sensors.

TCO$_2$M Monitor Front Panel

The *TCO$_2$M* Monitor, Model 860 front panel includes dedicated function keys, menu dependent "softkeys" and illuminating icon symbols. A Red Alert Bar, sensor, and Model 868 Calibrator input connections also appear on the front panel.



or **Power** — Turn the monitor power on and off.

Low Bat — Icon illuminates red when operating on battery power and 15 minutes of battery life remain.

- A similar icon appears in the display when the monitor is running on battery power and gives a visual indication of the charge left on the battery.

AC ON — Icon illuminates green when the monitor is connected to AC power and the rear panel power switch is set to "|" (ON). Also indicates the battery is charging.

Two Minute Silence Icon illuminates yellow when the audio has been temporarily silenced using the Two Minute Silence feature.

Audio key Enable or disable audible alerts.

Audio Icon Flashes yellow to indicate an Audio Off condition in which audible limit alerts will be prevented.

Alert Reset Acknowledge and reset alerts.

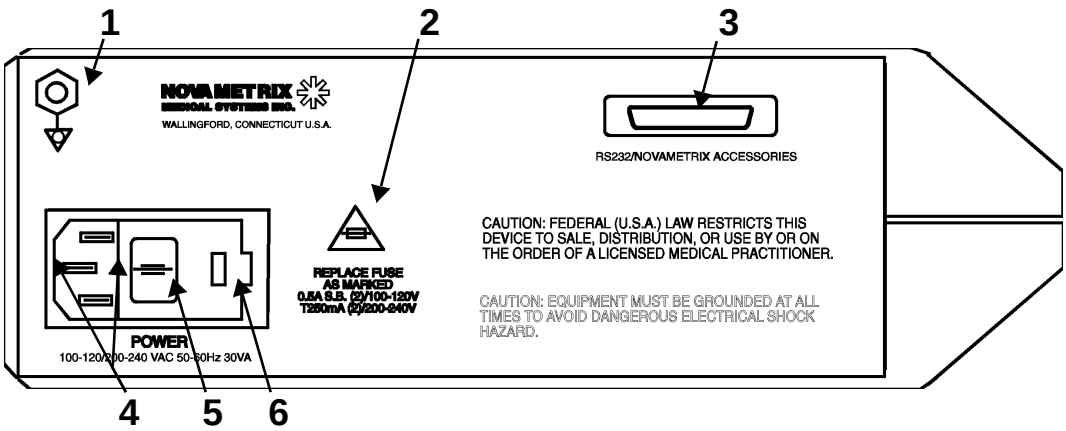
Alert Icon Flashes red to indicate an alert condition.

Softkeys Five keys that function according to the command shown above each key in the display.

Event Mark a user defined “Event” in trend memory (viewed from Trend Page).

Contrast Press to vary the display’s contrast setting for optimum viewing.

TCO_2M Monitor Rear Panel



1 Ground stud. Use to connect monitor’s chassis to earth ground.

2 Indicates fuse rating information for mains fuse.

3 Data Input/Output port for external peripherals.

4 Power cord receptacle and power cord retaining clip. Plug power cord into this receptacle. Use only hospital grade three wire plugs for connection via supplied power cord.

5 AC Line Power (Mains) Switch. Set to “|” allows AC mains to power the monitor, set to “O” switches AC mains power off.

6 Voltage select/fuse compartment - Sets mains operating voltage and houses mains fuses.

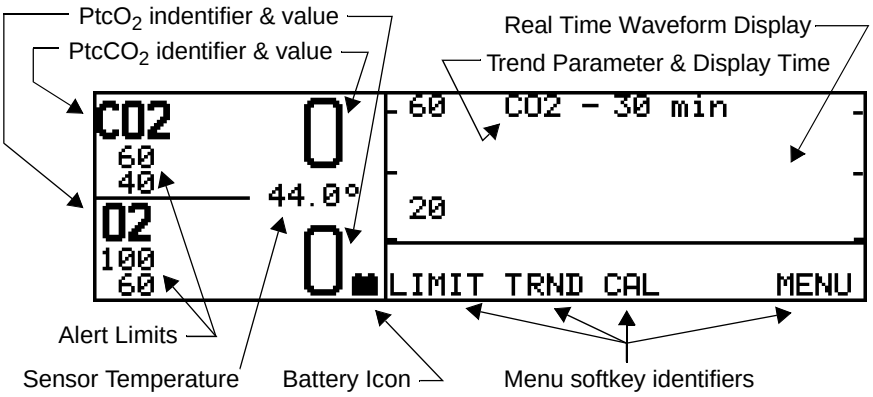
Symbols

Equipotentiality	Connection to monitor’s chassis.
Ground	Protective earth ground connection.
Dangerous Voltage	High voltages present.
Patient Isolation	Identifies patient isolation connection as type BF.
Attention	Consult manual for detailed information.
Mains Fuse	Mains fuse rating for replacement fuses
Mains Power	AC mains switch “|” ON-connection to mains; “O” OFF-disconnection from mains.

TCO_2M Monitor Display

The display is arranged in different sections; parameter information for $PtcCO_2$ and $PtcO_2$, real time waveform display, and the menu display. A full screen trend display is also available. *TCO_2M* allows great flexibility in the way that data is displayed, so

your screen may not match this one; especially if you are using a single parameter (CO_2 or O_2) sensor.



Transcutaneous Sensor Overview

Select sensor

Select a sensor based on monitoring need and availability. Several transcutaneous sensors can be used with the *TCO_2M* including; Combination O_2/CO_2 Sensor with split membrane NOVADISK 4474-00, Combination O_2/CO_2 Sensor 4474-39, Transcutaneous O_2 Sensor 6754-00, and Transcutaneous CO_2 Sensor 6752-00.

Ensure the selected sensor is mechanically sound; with no broken, frayed, or exposed wiring. Ensure the NOVADISK membrane assembly is intact and clean, use a alcohol wipe to clean the sensor and membrane face if necessary. Refer to the appropriate sections of this manual for specific sensor preparation instructions.

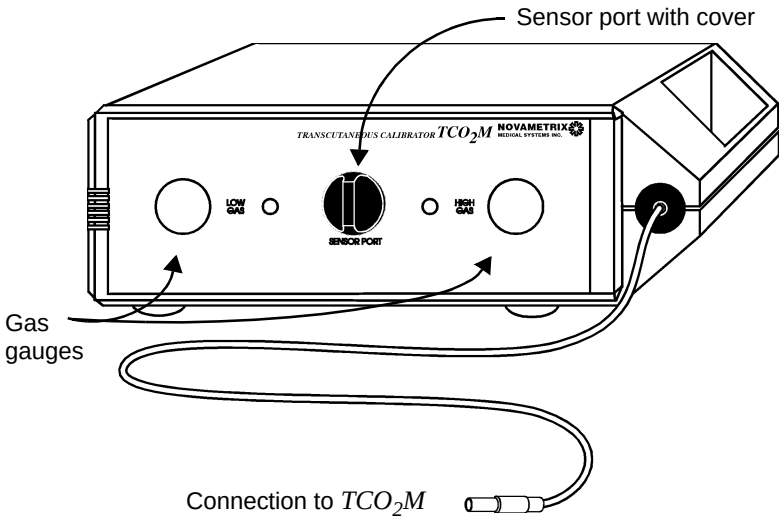
Connect sensor

Connect a sensor to the *TCO_2M*, by aligning the pins of the sensor connector with those on the monitor's front panel input connector and pushing the sensor connector into place. The sensor should "click" into place when correctly seated.

TCO_2M Calibrator, Model 868

The *TCO_2M* Calibrator, Model 868 is intended to be used with the *TCO_2M* Transcutaneous Monitor, Model 860. The calibrator is used to expose a transcutaneous sensor to two precision gas mixtures as part of the sensor's

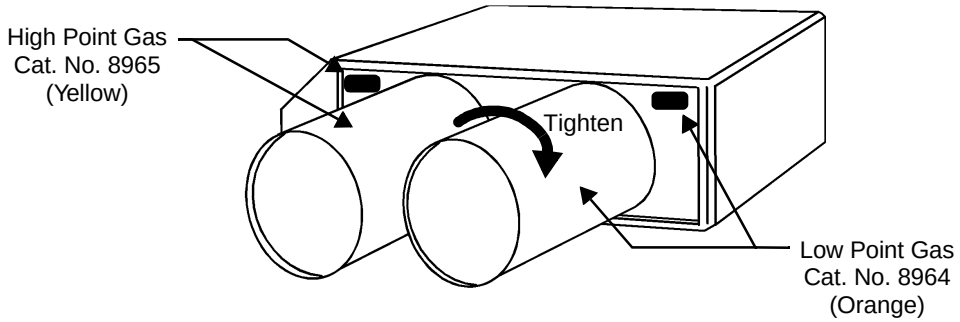
calibration. The Monitor controls the actions of the Calibrator as well as providing power to the Calibrator.



Setting up the Calibrator

To install calibration gas cylinders:

1 Check the cylinder part number and label color against the part number and color identifier on the rear panel.



2 Insert a Low Point Calibration Gas (Cat. N0. 8964) cylinder into the appropriate opening at the rear of the calibrator. Hand tighten the cylinder by rotating it in a clockwise direction until is firmly seated against the in the calibrator, then 1/4 turn more. The cylinder should turn easily, if not, remove and try again. Do not force it.

3 Install High Point Calibration Gas (Cat. N0. 8965) cylinder in the same manner.

4 Verify that both front panel pressure gages indicate pressures above zero.

Disconnecting Gas Cylinders

When the front panel pressure gauge reads 0 (while a cylinder is connected) the cylinder is empty and must be replaced. Do not attempt to calibrate a sensor with an empty cylinder.

To remove a cylinder:

1. Rotate the cylinder in a counter clockwise direction until free.
2. Dispose of cylinder in accordance to local regulations.

CAUTION: Do not attempt to refill empty cylinders or to dispose of in fire. Refer to labeling on cylinder for proper handling and disposal.

Connect the calibrator

Connect the calibrator to the *TCO_2M* by aligning the red dot on the calibrator cable connector with the red dot on the monitor's front panel calibrator input connector and pushing the calibrator connector into place. It "clicks" into place when correctly seated.

5 Operating the Monitor

This section includes information on operating the ***TCO$_2$M*** Transcutaneous Monitor, Model 860 including power on/off and AC/Battery operation. This section also details the monitoring of oxygen and carbon dioxide tension, and the principles of sensor operation.

TCO$_2$M Power-up

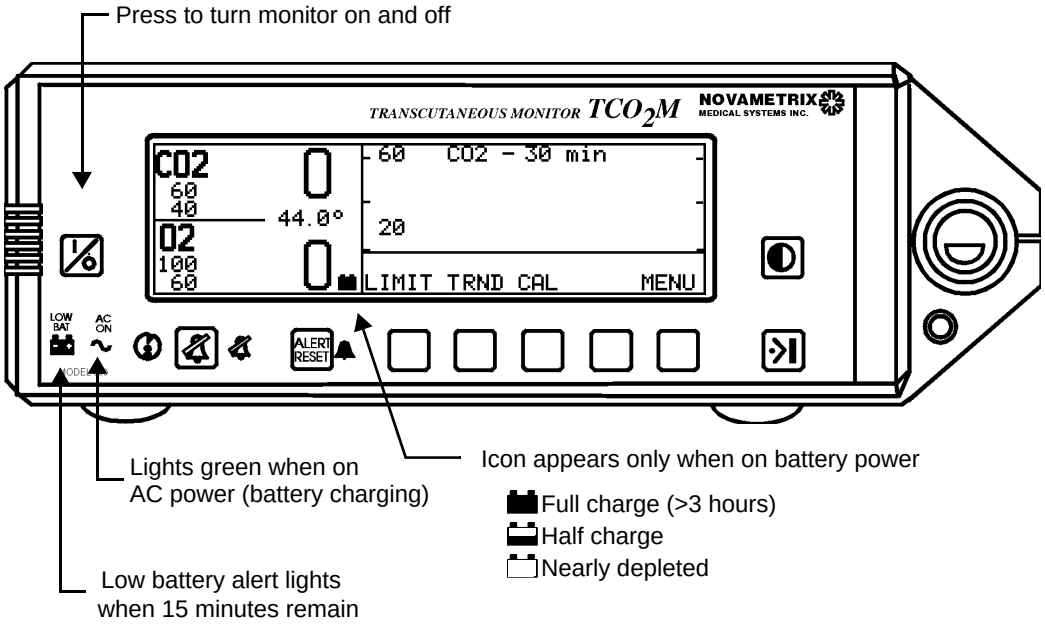
Power On/Off

Press the front panel key to turn the monitor on or off. At power-up the monitor will:

- Perform a "lamp test" where the display and indicators light (**AC ON** icon will not light when powered by battery).
- Produce an audible "beep" indicating the audio is functional.
- Performs a self test; "**MONITOR PERFORMING SELF TEST**" is displayed.
- Display the base menu.

AC/Battery operation

The ***TCO$_2$M*** can be powered from the AC line (Mains) or from its internal battery. The front panel **AC ON** icon illuminates green when operating from the AC line, and remains off when ***TCO$_2$M*** is being powered from its battery.



AC Line Power

To power *TCO_2M* from the AC line power source:

1. Set the rear panel power switch to the "|" (ON) position.
2. Plug the line cord into the rear panel power cord receptacle and into a properly grounded 3-wire outlet.
3. Verify the green AC ON icon ∿ illuminates.

Battery Power

To power *TCO_2M* from its internal battery:

1. Do either or both of the following;
   — Set the rear panel power switch to the "O" (OFF) position, or
   — Unplug the line cord from the rear panel power cord receptacle or AC outlet.
2. Verify the green AC ON icon ∿ is NOT illuminated.

Operating on battery

A fully charged battery will power the monitor for over three hours. While on battery power, the display shows a battery icon that "drains" as battery charge is depleted; from a full charge, to half-charge, to nearly depleted. The monitor may not power up on battery power if the battery is not sufficiently charged. See "Charging the battery" below.

NOTE: Excessive alerting reduces battery life when operating on battery power.

Low battery alert

When 15 minutes of battery life remain, the LOW BAT low battery indicator illuminates red. If the monitor continues to be powered from its internal battery for more than 15 minutes after a low battery alert occurs, the monitor's display blanks except for the message BATTERY VERY LOW PLUG IN AC POWER. All indicators (except AC ON ∿) illuminate and a continuous audible tone sounds. Reconnect the AC power or the monitor will automatically shut itself off.

Charging the battery

To recharge the battery, plug in the line cord and set the rear panel power switch to the (|) ON position. A discharged battery will be fully recharged within 12 hours. The monitor may be operated, on AC power, while the battery is being recharged.

Long Term Storage

If the *TCO_2M* has not been used or connected to AC power (AC ON icon ∿ illuminated) for an extended time (e.g., 3 months or more) allow the battery to charge for 12 hours before use.

Battery replacement

The internal *TCO_2M* battery is not user replaceable. Should replacement become necessary, contact qualified technical service personnel. Replace only with a battery of the same type and rating.

Monitoring CO_2 and O_2 Tension

Sensor Stabilization

After the properly membraned and calibrated sensor is appropriately applied to the skin, the CO_2 will gradually rise from its room air value to a stabilized value. The O_2 value will drop from its room air value, then slowly increase to a stabilized value. Stabilization typically occurs within 10-15 minutes.

Carbon Dioxide and Oxygen Alerts

The *TCO_2M* has audible and visual alerts for both carbon dioxide and oxygen tension. Refer to “LIMIT — CO2 and O2 Alert Limits” on page 21.

Sensor Temperature Alerts

Any time the actual sensor temperature differs from the user-selected temperature by more than 0.2° C, a temperature alert will occur. If a temperature alert occurs, the alert indicator 🔔 and the red alert bar start to flash. The message center displays TEMP > 0.2° C and audible alarm (that overrides Audio Off) sounds. The visible and audible alarms will automatically reset if the temperature returns within the 0.2° C limits. The temperature audio is disabled for the first three minutes after the monitor is turned on—allowing the sensor to heat up without generating an alarm condition.

Do not confuse a Site Timer Expired induced sensor heater power shutdown with a temperature fault. Refer to “Site Timer” on page 33.

A temperature fault condition may occur if the sensor is damaged or if the monitor fails. The message center will display “MONITOR ERROR TEMPR. ERR-HTR OFF” and an audible alarm (that overrides Audio Off) will sound. The monitor will automatically shut down the heater power to the sensor, thus eliminating the risk of a sensor-induced heat-related skin damage. A temperature fault can only be reset by turning the monitor off and then back on.

> ⚠ *WARNING: If a temperature fault occurs, the sensor should immediately be removed from the patient. Contact qualified service personnel before putting either the monitor or sensor back into use.*

PtcCO₂ Display Values

The CO_2 display reading is factory set to reflect the metabolic factor for pCO_2. This means that the CO_2 values have been adjusted for the increased metabolic production of CO_2 and the anaerobic temperature coefficient induced by the application of a heated sensor. The CO_2 value measured with a heated transcutaneous sensor is significantly greater than the pCO_2 in the arteries for the following reasons:[1]

- Anaerobic temperature coefficient of blood for carbon dioxide.

1. Monaco, F., McQuitty, J.C., Nickerson, B.G. Calibration of a Heated Transcutaneous CO2 Electrode to Reflect Arterial CO2. Am. Rev. Resp. Dis. 1983; 127:322.

- Increased local CO_2 production due to increased metabolism of heated epidermal tissue beneath the sensor.
- The arteriole-cellular CO_2 difference.

The *TCO_2M* automatically corrects the $PtcCO_2$ during patient monitoring (not during sensor calibration) to compensate for these metabolic factors related to the temperature effect and CO_2 production. The correction is accomplished via the following formula;[2]

$$pCO_2(37°C) = PtcCO_2 \times (10^{0.019 \times (37\text{-}Tsensor\ °C)}) - 4$$

pCO_2(37° C) - $PtcCO_2$ value in mmHg corrected to 37° C assuming a patient temp of 37° C

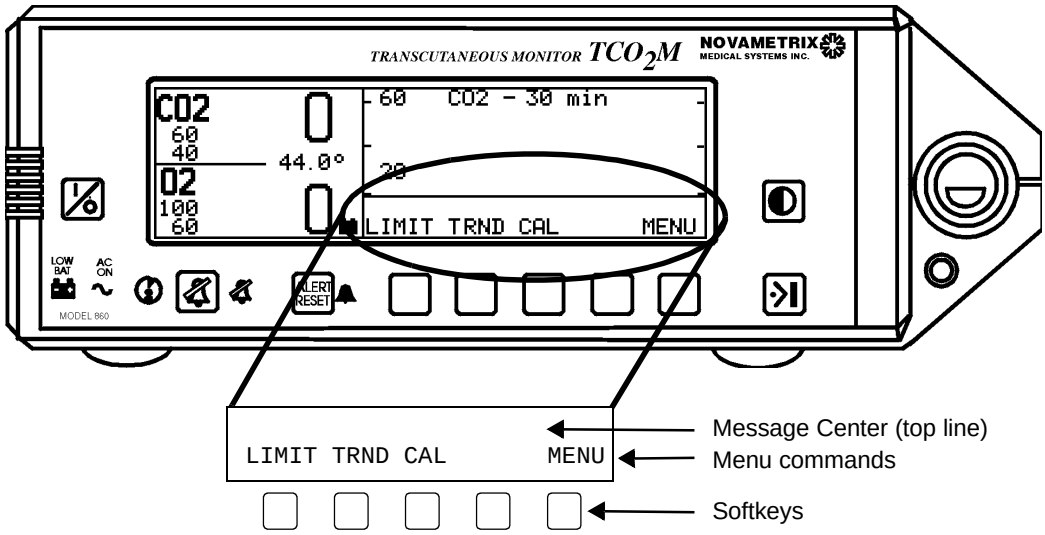
$PtcCO_2$ - value of $PtcCO_2$ in mmHg measured by the sensor

If the correction factor has been disabled, the message "OFF" (metabolic correction factor off) flashes beside and to the right of the displayed CO_2 value. Refer to "Metabolic Correction Factor" on page 67 for details.

2. Severinghaus, J.W. Transcutaneous Blood Gas Analysis Respiratory Care 1983; 27(2): 152

6 Menu Operation and Setup

The *TCO$_2$M* uses a simple menu system with helpful messages to guide the user through setup and alert conditions. To operate the menu system, press the softkey beneath the desired menu command. System prompts and alert messages are displayed in the "Message Center" above the menu commands.



Menu Structure

The *TCO$_2$M* menu structure is divided into two parts; the User and Advanced menus. The User menu includes basic menu commands needed to operate the monitor on a daily basis. The Advanced menu contains setup/configuration commands that affect how the system operates, but that are typically not used in everyday monitoring. The User menu commands are detailed below. The Advanced menu commands are detailed in "Advanced Controls and Features" on page 63.

LIMIT — CO_2 and O_2 Alert Limits

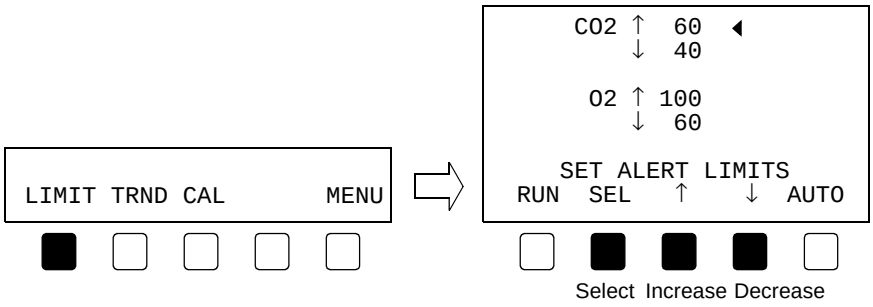
The *TCO$_2$M* has audible and visual alerts for both carbon dioxide and oxygen tension. The *TCO$_2$M* is very flexible in handling alerts because it provides several alert options.

- Alert limits can be adjusted manually or automatically with the Auto Alerts feature.
- Each individual limit may be turned off.
- Limit alerts require user action to be reset; but can be set to automatically reset.
- Alert limit settings are retained in memory and restored each time the monitor is turned on; but the monitor can be set to power up each time using default settings.
- Audible alerts are delayed 10 seconds from the occurrence of a limit alert; but the delay can be eliminated to allow instant activation.
- Audible alert volume can be adjusted.
- The audible alert and red alert bar suppressed for two or ten minutes.
- Audible alerts can be suppressed altogether via the Audio Off feature; and the Audio Off feature can itself be disabled if suppressing audible alerts is undesired.
- The red alert bar stops flashing automatically if the parameter that caused a limit alert returns within its limits but it can instead be set to continue flashing until the user presses **ALERT RESET**, or the red alert bar can be turned off altogether.

Set Alert Limits

To set the CO_2 and O_2 alert limits:

1 Press **LIMIT** and SET ALERT LIMITS appears.



2 Use the **SEL** key to move the ◀ (left pointing arrow) to highlight a limit value.

3 Use the ↑ and ↓ (up/down arrows) to increase/decrease the limit value.

The monitor will not allow a parameter's high and low limits to be set within 5 mmHg (0.5 kPa) of each other. If the lower limit is raised to within 5 mmHg of the upper limit, the upper limit will automatically increase to maintain the 5 mmHg difference. If the upper limit is adjusted downward to within 5 mmHg of the lower limit, the lower limit will automatically decrease to maintain the 5 mmHg difference.

Decreasing an upper limit below 5 or a lower limit below 1 causes that limit to be turned OFF. If alert limits are displayed the limit shows as OFF; if alert limits are not displayed, the message center indicates that the alert is turned off.

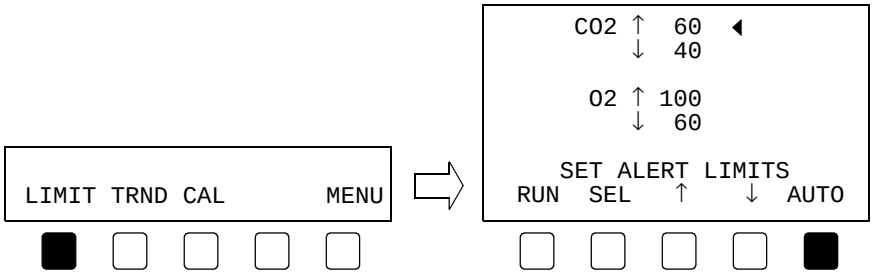
4 Press **RUN** to return to the main menu.

Auto Alert Limits

Auto Alerts allow the user to bracket alert limits about the CO_2 and O_2 display values.

To set Auto Alert Limits:

1. Press **LIMIT** and SET ALERT LIMITS appears
2. Press **AUTO**. The alerts are bracketed about the display value.



Auto alerts are bracketed about the display value for CO_2 and O_2. If one or both parameters is displaying a value less than 10 mmHg (1 kPa) when **AUTO** is pressed, the message NOT ENOUGH DATA TO SET AUTO LIMITS is briefly displayed and that parameter's limits are not adjusted; however, the other parameter's limits will be adjusted.

Carbon Dioxide Auto Alert-Limit Determinations:

$PtcCO_2$ Display Value	$PtcCO_2$ Limit Setting
$PtcCO_2 \leq 10$ mmHg	no change
10 mmHg < $PtcCO_2$ < 41 mmHg	$PtcCO_2 \pm (PtcCO_2/4)$ mmHg
$PtcCO_2$ > 40 mmHg	$PtcCO_2 \pm 10$ mmHg

Oxygen Auto Alert-Limit Determinations:

$PtcO_2$ Display Value	$PtcO_2$ Limit Setting
$PtcO_2 \leq 10$ mmHg	no change
10 mmHg < $PtcO_2$ < 101 mmHg	$PtcO_2 \pm 10$ mmHg
$PtcO_2$ > 100 mmHg	$PtcO_2 \pm 20$ mmHg

Limit Alerts

Definitions: Limit Alerts—audible and visible signals from the monitor, are generated in response to CO_2 or O_2 values outside the range of the Alert Limits—the maximum and minimum allowable values for CO_2 or O_2.

If the $PtcCO_2$ or $PtcO_2$ value violates an alert limit setting;

- The violated alert limit (if displayed) starts to flash. If limit values are not displayed, an ↑ or ↓ arrow flashes beside the CO_2 or O_2 display identifier.
- The red 🔔 (bell-shaped) indicator beside the **ALERT RESET** key flashes.
- A message flashes in the Message Center (e.g., CO2-LOW).

If the value returns within its limits within 10 seconds (if 10 sec alert delay is on);

- The red 🔔 indicator, violated limit display and alert message stop flashing.

If the limit alert lasts for more than 10 seconds (or the 10 sec alert delay is off);

- An audible alarm will sound and the red alert bar flashes. Two Minute Silence, Audio Off and Alert Delay will suppress the audible alert. Two Minute Silence and Alert Delay will suppress the flashing red alert bar.

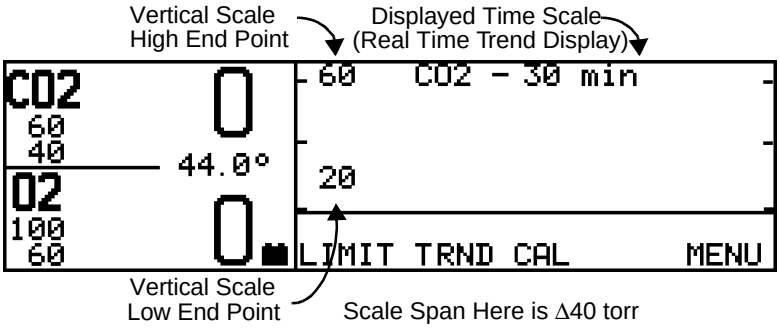
If the value returns within limits after 10 seconds of alerting

- The audible alarm and red alert bar will turn off.
- The red 🔔 indicator and violated limit display (value or arrow) continue to flash until the user presses the **ALERT RESET** key. (This allows the user to determine which limit was violated.)

TRND — Real time trend displays

Real Time Trend

The *TCO_2M* can display real time graphic trends of CO_2, O_2 and Local Power data. The user can easily customize the real time trends to show the most recent 10, 20 or 30 minutes of CO_2, O_2 or Local Power data, and to change the vertical scale as needed.



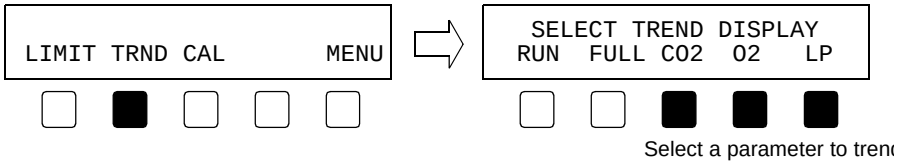
Show CO_2 /O_2/LP

To change real time graphic trend to reflect CO_2, O_2, or LP data:

1 Press **TRND** and SELECT TREND DISPLAY appears.

2 Press **CO2**, **O2** or **LP** to select the desired parameter.

The softkey for the currently displayed parameter flashes.



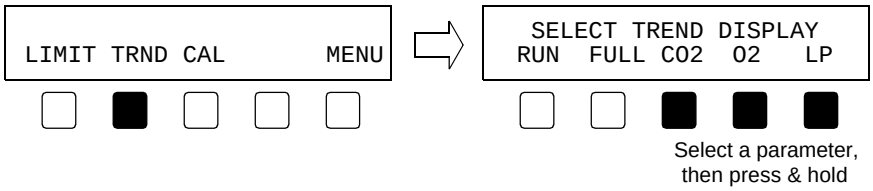
3 Press **RUN** to return to the base menu.

Set Trend Time

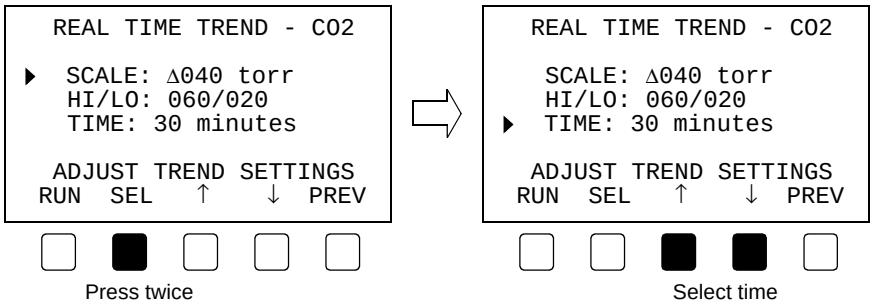
To change real time graphic trend time scale:

1 Press **TRND** and SELECT TREND DISPLAY appears.

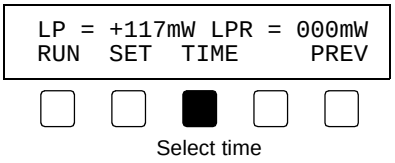
2 Press and hold **CO2**, **O2** or **LP** until ADJUST TREND SETTINGS appears.



3 If in Step 2, you pressed **CO2** or **O2**, now press **SEL** twice to highlight TIME. Press ↑ or ↓ (up/down arrows) to select a 10, 20, or 30 minute time scale. Skip to Step 5.



4 If in Step 2, you pressed **LP**, now press **TIME** repeatedly to select a 10, 20, or 30 minute time scale.



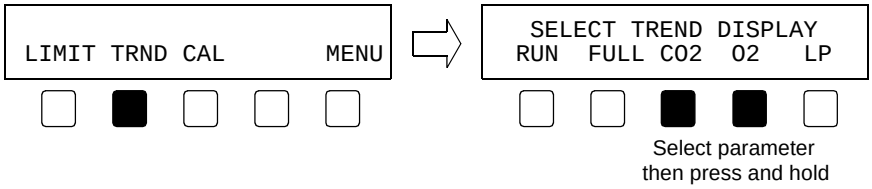
5 Press **RUN** to return to the base menu.

Set CO2/O2 scale

To change the real time graphic trend scale for CO_2 or O_2:

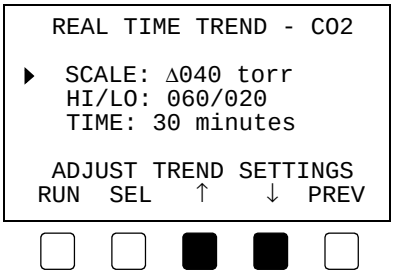
1 Press **TRND** and SELECT TREND DISPLAY appears.

2 Press and hold **CO2** or **O2** until ADJUST TREND SETTINGS appears.



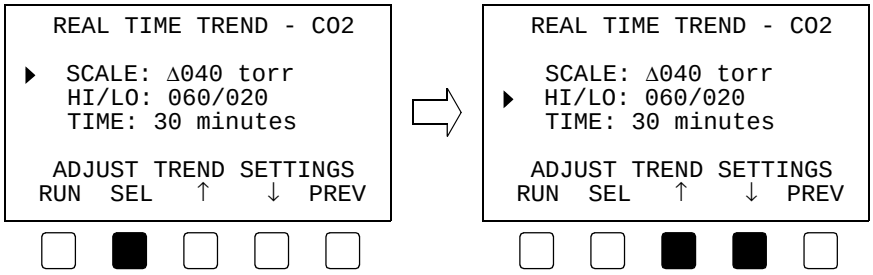
3 To change the scale, press the ↑ or ↓ (up/down arrows) to select the desired delta—the distance between HI and LOW values.

The vertical scale changes in units of 40 (e.g., 40, 80 120, etc.).The actual start and end points are determined by the HI/LO selection detailed next.



4 To change the actual HI and LOW scale values, press **SEL** to highlight HI/LO and then press the ↑ or ↓ (up/down arrows) to select the desired points on the scale.

The selected scale requires a start and stop point for display on the vertical axis. These points can be adjusted here. The end points for the vertical axis will change keeping the chosen scale as the determining factor of the high and low values. For example; if the scale is set at 40, the HI/LO values will always be 40 units part, the high end point will be 40 units higher than the low point.



5 Press **RUN** to return to the base menu.

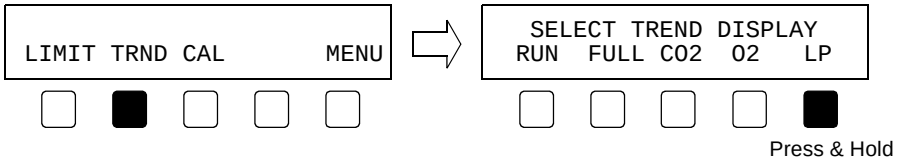
Local Power (LP and LPR)

Once the sensor is stabilized on the skin, the Local Power Reference (LPR) can be set. The LPR shows the amount of electrical power required by the sensor to maintain its operating temperature. The unit of power measure is the milliwatt (mW). Once set, the LPR value will not vary until a new value is set by the user (see below). Any real-time fluctuations to the LPR value (caused by changes in heater power requirements) are displayed as a plus or minus value in the Local Power (LP) display and in the real time LP trend as values above (more power) and below (less power) the centerline (the LPR value).[1]

To set the local power reference:

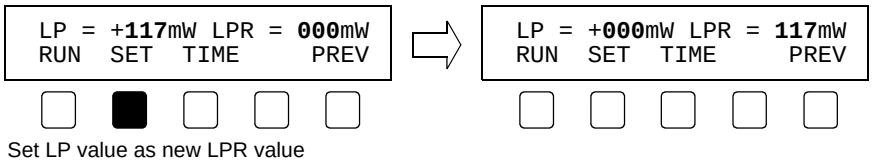
1. For further information refer to; Peabody, J.L. Willis, M.M. et al. Reliability of Skin (tc)PO_2 Electrode Heating Power as a Continuous Noninvasive Monitor of Mean Arterial Pressure in Sick Newborns. Continuous Transcutaneous Blood Gas Monitoring 1979: 127-133. Refer also to; A User's Guide to Transcutaneous Gas Monitoring Novametrix Medical Systems Inc., Medical Education Division, September 1983.

1 Press **TRND** and SELECT TREND DISPLAY appears.



2 Press and hold the **LP** softkey until the LP and LPR values appear.

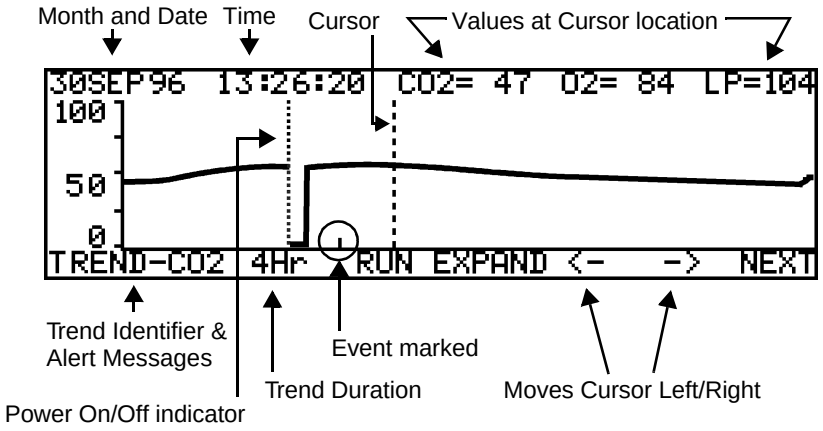
3 Press **SET** to set the local power reference.



4 Press **RUN** to return to the base menu.

TRND — Trend Page (stored trend memory) displays

The *TCO$_2$M* maintains trend information for CO_2, O_2, and local heater power. The 24-hour battery backed trend memory is continually and automatically updated every eight seconds. Trend displays are user selectable to show any 12, 8, 4, or 2 hour, or 30 minute portion of trend memory as a graphical trend or histogram. User selected "Events" are stored in trend memory and displayed. Trend memory can be erased via the monitor startup or Trend Page menus—trend memory is not erased by a simple power off-power on cycle.



New trend data is continually collected and enters the graph from the right—pushing older already displayed data towards the left. (If less than 12 hours of data have been collected, the graph will be shortened accordingly.) Points in the trend where the monitor was turned off are indicated by dotted vertical lines.

A cursor, the dashed vertical line flashing in the display, can be moved along the time base to display the CO_2, O_2, and local power value at any point in the trend. The cursor is controlled by left and right arrow keys. Press and hold the softkey to increase cursor speed.

Information displayed above the graph is specific to the data at the cursor. The information above the graph includes; the date in the form DDMMMYY (30SEP96), the time in 24 hour format in the form HH:MM:SS (13:30:00 = 1:30 p.m.), CO2 and O2 in mmHg or kPa as the monitor is configured, and LP in mW.

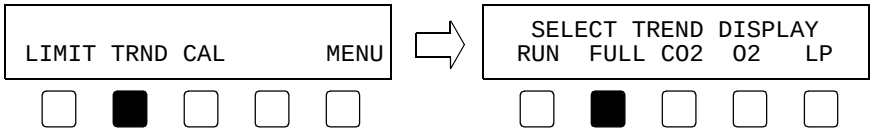
EVENT is displayed when the cursor is moved over a area in the trend where an Event was marked by the user.

> The *TCO_2M* continues uninterrupted patient monitoring while displaying trends. Alerts that occur are identified in the lower left corner of the trend page display. If no keys are pressed for 5 minutes, the base menu replaces the trend display.

Show trend page

To display the full trend page:

1. Press the **TRND** softkey and SELECT TREND DISPLAY appears.
2. Press **FULL** and the Trend Page display appears.

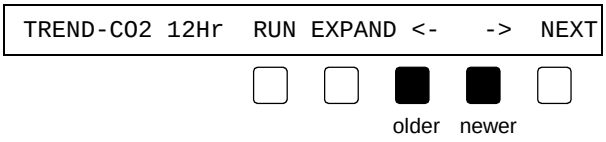


3. Press **RUN** to return to the base menu.

Moving in trend

To navigate through the trend page display:

1. Display the trend page (press **TRND** then **FULL**).
2. Move the cursor by pressing the **<-** or **->** (arrow keys) to the desired time.
   Press the **<-** (arrow left) key to move the cursor towards older data.
   Press the **->** (arrow right) key to move the cursor towards more recent data.



   Information displayed above the graph is specific to the data at the cursor—the flashing dashed vertical line in the display.

3. Press the **EXPAND** softkey.

   Successive presses of the **EXPAND** key cycles through the 12, 8, 4 and 2 hour and 30 minute trend displays. Expansion occurs about the cursor.

4. Use the arrow keys to fine tune the cursor to the desired location in the trend.

5 Press **RUN** to return to the base menu.

Select trend page parameter

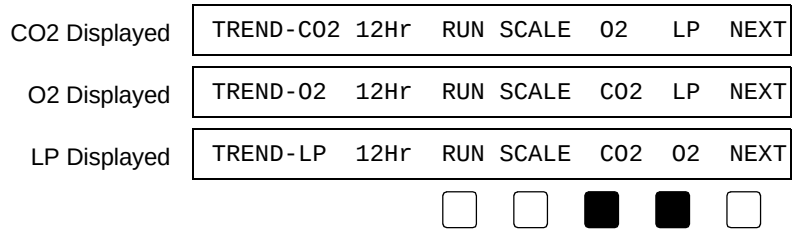
When first selected, the trend page will display the same parameter as displayed by the real time trend. The user can change the trend page to display LP as well as CO_2 or O_2 (provided the sensor in use supports those parameters).

To change to the trend page display parameter:

1 Display the trend page (press **TRND** then **FULL**).

2 Press **NEXT**. The available trend page parameters are listed.

3 Press the **CO2**, **O2**, or **LP** key to display that parameter in the trend page.


CO2 Displayed
TREND-CO2 12Hr RUN SCALE O2 LP NEXT
O2 Displayed
TREND-O2 12Hr RUN SCALE CO2 LP NEXT
LP Displayed
TREND-LP 12Hr RUN SCALE CO2 O2 NEXT

Select trend scale

Each of the trend page supported parameters, CO_2, O_2 and LP, can be viewed using a “half” or “full” scale display setting. Each parameter scale is independent of the others.

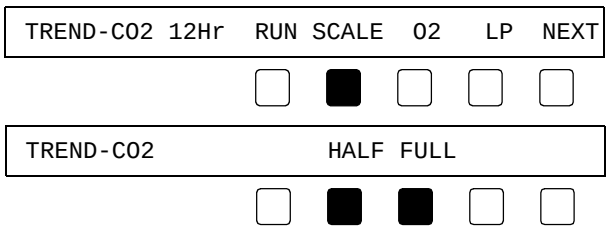
To change the trend page display scale of a parameter.

1 Display the trend page and select the parameter you desire.

2 Press **NEXT**.

3 Press **SCALE** and then select either the **HALF** or **FULL** scale setting.

CO_2: Half 0-60, Full 0-100. O_2 and LP: Half 0-100, Full 0-200

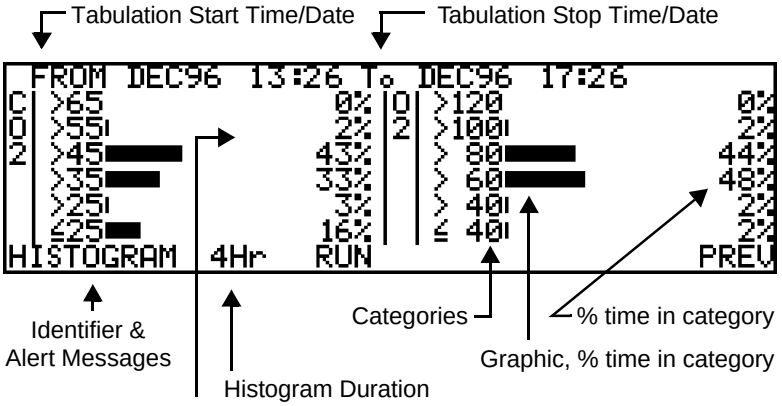


Show histogram

The histogram display provides a tabulated summary of CO_2 and O_2 trend data.

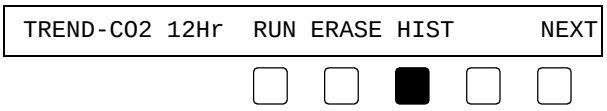
The histogram display reflects the currently selected graphical trend expansion setting. For example, if the graphic display is set to 12 hours, the resulting histogram will also reflect that 12 hours; and if the graphic display is set to 30 minutes, the resulting histogram only uses those 30 minutes as the basis for its tabulations. The top line of the histogram display shows the start and stop dates and times (24 hour format) used to tabulate the data.

CO_2 and O_2 data is tabulated into six categories. Each category represents a range of possible values. For each category, a bar graph is drawn showing the percentage of the total time the parameter was within the category. To the right of the bar graphs are numerical tabulations also showing how long the parameter was within that category. (Rounding errors may keep the total from being 100%).



To view the histogram page:

1. Press the **TRND** softkey and SELECT TREND DISPLAY appears.
2. Press **FULL** and the Trend Page display appears.
3. Press **NEXT** twice.
4. Press **HIST** (histogram) and the histogram page appears.



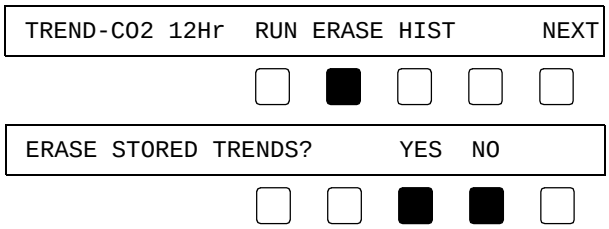
5. Press **PREV** to return to the trend page display
   - or -
   Press **RUN** to return to the base menu.

Erase trend memory

To erase the stored trends:

1. Press the **TRND** softkey and SELECT TREND DISPLAY appears.
2. Press **FULL** and the Trend Page display appears.
3. Press **NEXT** twice.

4 Press **ERASE** and ERASE STORED TRENDS? appears.



5 Press **YES** to permanently erase the contents of the trend memory
- or -
Press **NO** to cancel the function and leave trend memory intact.

If **YES**, then ERASING TREND PLEASE WAIT is briefly displayed, followed briefly by TREND ERASED. The base menu then reappears.

If **NO**, TREND RETAINED is briefly displayed. The trend page reappears.

Trend Data Compression

CO_2, O_2 and LP data is stored in trend memory every eight seconds. The *TCO_2M* can display any 12, 8, 4, or 2 hour or 30 minute portion of its 24 hour trend memory. Since the size of the trend display is a fixed width, the monitor must compress the trend data to fit onto the display—the more data present, the more it must be compressed to fit onto the display. The *TCO_2M* trend display is approximately 200 pixels (picture-element) wide. Each horizontal pixel (data point) is equivalent to the following times;

1 data point per 8 seconds in a 30 minute trend
1 data point per 32 seconds in a 2 hour trend
1 data point per 64 seconds in a 4 hour trend
1 data point per 128 seconds (approx. 2 minutes) in an 8 hour trend
1 data point per 192 seconds (approx. 3 minutes) in an 12 hour trend

The monitor determines the trend duration and compresses that amount of data to fit the screen—older data to the left, the most recent to the right. Because of the data compression, data at any horizontal pixel may look like a vertical bar. The upper extent of the bar represents the maximum value and the bottom of the bar the minimum value stored during that particular compression period. The values displayed above the graph represent the minimum values stored over the compression period.

CAL — Sensor calibration

The *TCO_2M* attempts to simplify sensor calibration by combining various aspects of sensor calibration under a single CALibration menu feature. This section details the steps necessary to properly select and configure sensor temperature, barometric pressure, and site timer settings, as well as detailing the Last Calibration information display.

Calibrate sensor

Refer to “Sensor Calibration” on page 37, to actually perform a sensor calibration.

Set temperature

The transcutaneous sensor is heated to facilitate the diffusion of CO_2 and O_2 through the skin to the sensor. When the *TCO_2M* is powered up, the sensor is automatically heated to the operating temperature that was last selected by the user. This temperature may be set from 37° C to 45° C in 0.5° C steps.

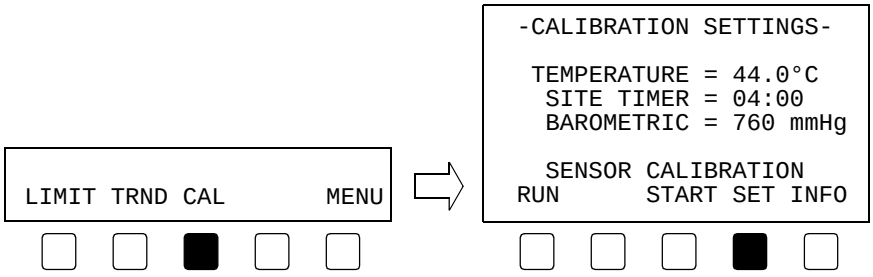
The actual sensor temperature is normally displayed in the base menu. Note that until the sensor temperature rises above 30° C, the display will show "--.-".

Sensor calibration is based, in part, on the sensor temperature. Therefore, the sensor should be calibrated at operating temperature. If the temperature setting is changed by more than 0.5° C, the sensor should be recalibrated at the new temperature. See "Sensor Calibration" on page 37. The recommended sensor temperatures are:

Cat. No.	Sensor Type	Neonate	Adult
4474	Combination O_2/CO_2 Sensor	44° C	44° C
6752	Carbon Dioxide Sensor	44° C	44° C
6754	Oxygen Sensor	43-44° C	44-45° C

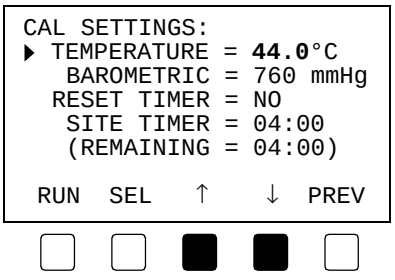
To change the temperature setting:

1 Press **CAL** and SENSOR CALIBRATION appears. The temperature setting is displayed.



2 If the temperature needs adjustment, press **SET** and CAL SETTINGS appear.

3 With the ▶ (highlight triangle) beside the TEMPERATURE setting, press the ↑ or ↓ keys to change the temperature to the desired value.



4 Press **RUN** to return to the base menu
- or -
Press **PREV** to return to the SENSOR CALIBRATION menu.

Site Timer

Because the transcutaneous sensors are heated to aid in the diffusion of CO_2 and O_2 from the skin to the sensor, the location of the sensor on the skin must be changed periodically to avoid heat induced damage to the skin at the sensor site. The *TCO_2M* has a site timer feature to remind the user to change the sensor site.

> *WARNING: The location of the sensor must be changed periodically to eliminate the risk of skin damage due to the heating of the skin by the sensor.* Risk of such skin damage depends on sensor temperature, duration of application, and physiological parameters including local perfusion, body temperature and skin thickness.

Generally, for neonates, the sensor site should be changed every 2-4 hours when using a temperature of 44° C, and every 4-6 hours at a sensor temperature of 43° C. For adults, the sensor site should be changed every 4-6 hours when using a temperature of 44° C. *Note that these times are guidelines only. The user should verify the duration for each patient.*

The monitor's site timer is automatically reset, to the user preselected duration, at the conclusion of each successful sensor calibration, and when the RESET TIMER option is set to YES in the CAL SETTINGS menu. A SENSOR SITE TIMER IS RESET TO XX:XX message (where xx:xx is the time in hours and minutes) is briefly displayed after calibration of the sensor. If the site timer is turned off (set to 00:00) a SENSOR SITE TIMER IS OFF message is briefly displayed.

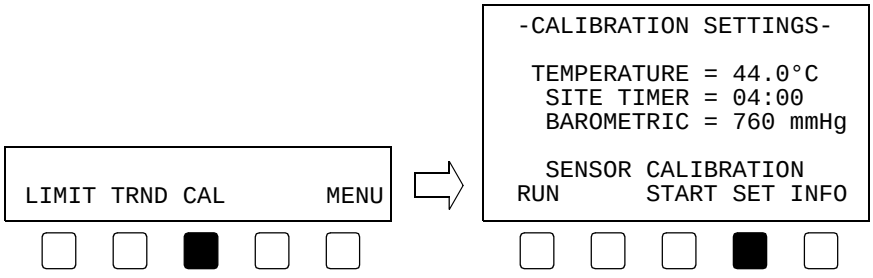
Once the site timer's remaining time expires, the alert indicator 🔔 starts to flash as does the red alert bar. An audible alarm will sound, overriding a disabled audible alert (Audio Off), and the message center will display S- TIMER EXPRD. The user should then remove the sensor from the patient. The two minute silence procedure will suppress the audible alert.

If the user does not reset the site timer alert within 10 minutes, the monitor will automatically shut down the heater power to the sensor, thus eliminating the risk associated with continued heating of the skin. If sensor heater power shutdown occurs, the message center flashes 10 MIN SITE TIMER EXPIRED and an audible alarm will sound overriding audio off mode if enabled. The user must then reset the site timer in the CAL SETTINGS portion of the SENSOR CALIBRATION menu.

Reset site timer

To reset the site timer to its original duration (REMAINING=SITE TIMER):

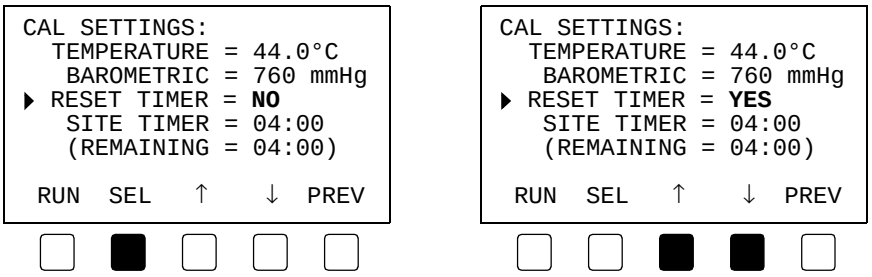
1 Press **CAL** and SENSOR CALIBRATION appears.



2 Press **SET** and CAL SETTINGS appear.

3 Press **SEL** to move the ▶ (highlight triangle) beside the RESET TIMER setting.

4 Press the ↑ or ↓ keys to change the setting from NO to YES.

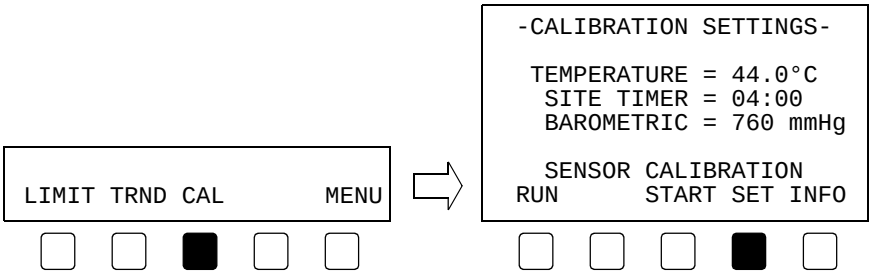


5 Press **RUN** to return to the base menu
- or -
Press **PREV** to return to the SENSOR CALIBRATION menu.

Adjust site timer

To adjust the site timer duration:

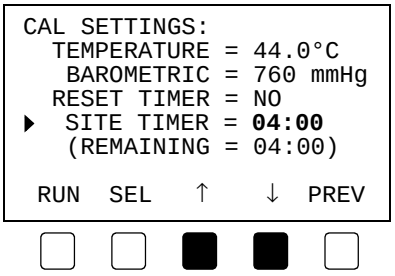
1 Press **CAL** and SENSOR CALIBRATION appears. The site timer setting is displayed.



2 If the site timer needs adjustment, press **SET** and CAL SETTINGS appear.

3 Press SEL to move the ▶ (highlight triangle) beside the SITE TIMER setting.

4 Press the ↑ or ↓ keys to change the site timer to the desired value.



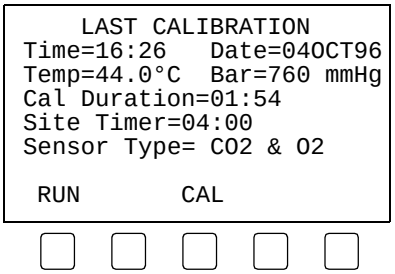
5 Press **RUN** to return to the base menu
- or -
Press **PREV** to return to the SENSOR CALIBRATION menu.

Last Calibration information

Once a sensor is calibrated, the calibration information is retained memory. This Last Calibration information can be displayed and "remembered" even if the sensor is removed or the monitor is turned off and back on. (If the *TCO_2M* memory is reset to factory defaults, the message UNKNOWN appears until a calibration is performed.)

To view information about the Last Calibration:

1. Press **CAL** and SENSOR CALIBRATION appears.
2. Press **INFO** and LAST CALIBRATION appears.



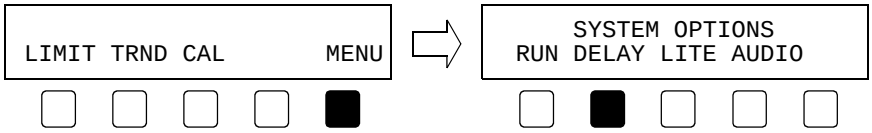
3. Press **CAL** to return to the SENSOR CALIBRATION menu.
   - or -
   Press **RUN** to return to the base menu.

DELAY — Suppress limit alerts

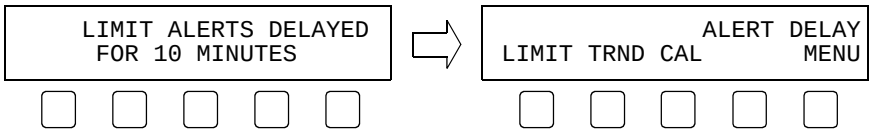
Set Alert Delay

To delay for ten minutes the audible alert and flashing red alert bar associated with an alert limit violation:

1. Press **MENU** and SYSTEM OPTIONS appears.
2. Press **DELAY**.



3. The display briefly shows LIMIT ALERTS DELAYED 10 MINUTES.



4. The base menu reappears and ALERT DELAY flashes in the message center.

   The indicator starts flashing and the red alert bar will not flash for ten minutes; after which the will turn off and the audible alert and red alert bar will again be enabled.

Note that if Audio Off is in effect when **DELAY** is pressed, the red alert bar is suppressed for 10 minutes and the Audio Off condition is unaffected.

Cancel Alert Delay

To enable the audible alert and red alert bar prior to expiration of the 10 minute Alert Delay:

1 Press the key.

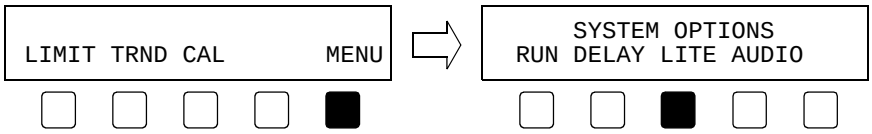
The indicator turns off, ALERT DELAY is removed from the message center, and the limit alerts (audible and red alert bar) become active again.

LITE — Display brightness

To adjust the display brightness:

1 Press **MENU** and SYSTEM OPTIONS appears.

2 Press **LITE** and the displays toggles between bright and dim settings.

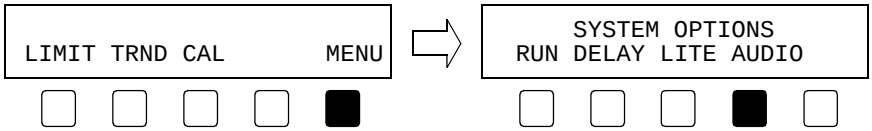


AUDIO — Adjust alert volume

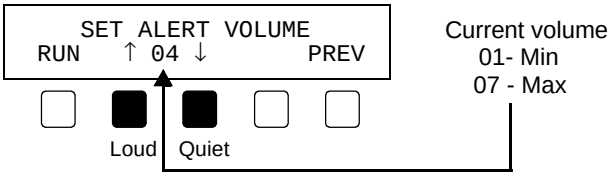
To adjust the audible alert volume:

1 Press **MENU** and SYSTEM OPTIONS appears.

2 Press **AUDIO** and SET ALERT VOLUME appears.



3 Press the ↑ (up arrow) key to make the audible alert tone louder (07 max).
- or -
Press the ↓ (down arrow) key to make the audible alert tone quieter (01 min).



4 Press **RUN** to return to the base menu.

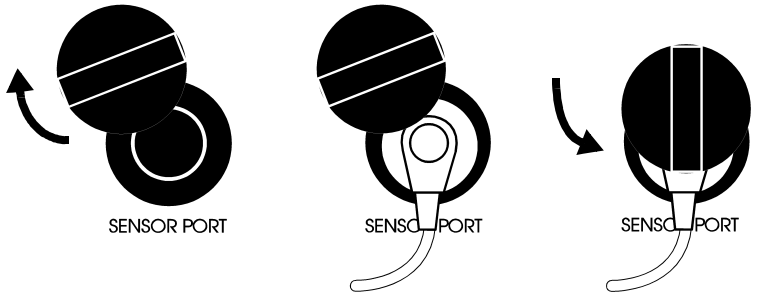
7 Sensor Calibration

Sensor Calibration with the TCO_2M Calibrator Model 868

This section describes the steps necessary to calibrate a transcutaneous sensor connected to the *TCO_2M* Monitor, using the *TCO_2M* Calibrator, Model 868.

To calibrate a sensor:

1. Ensure the sensor is properly prepared and connected to the monitor, the calibrator is connected, the monitor is on, and the sensor is at operating temperature.
2. Swing the Calibrator's sensor port cover up to expose the Sensor Port.

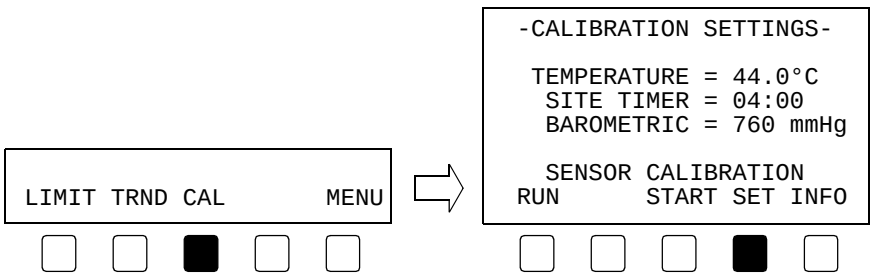


Step #1 Step #2 Step #3

3. Place the sensor into the Sensor Port.

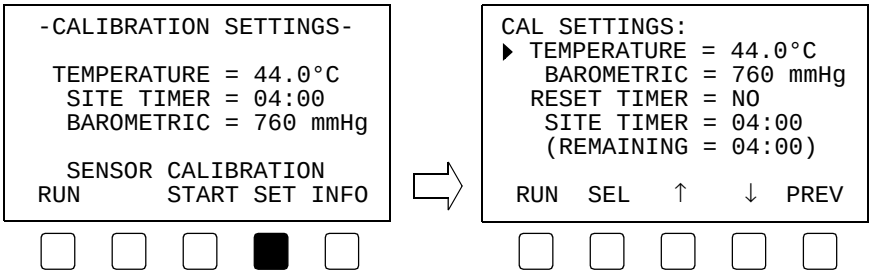
> Between site changes, clean the NOVADISK face (alcohol wipe) prior to placing in the calibrator. Lotions, skin oils or other residue may influence calibration.

4. Swing the cover piece down so as to secure the sensor in place.
5. Press the **CAL** softkey. The CALIBRATION SETTINGS menu appears.



6 Verify the setting for temperature and site timer are as desired and that the barometric pressure display is correct. If so, skip ahead to Step 11.

7 Press **SET** and the CAL SETTINGS menu appears.



8 Use the **SEL** key to move the selection triangle to highlight TEMPERATURE. Use the ↑ or ↓ keys select the desired temperature.

9 Use the **SEL** key to move the selection triangle to highlight SITE TIMER. Use the ↑ or ↓ keys select the desired timer duration.

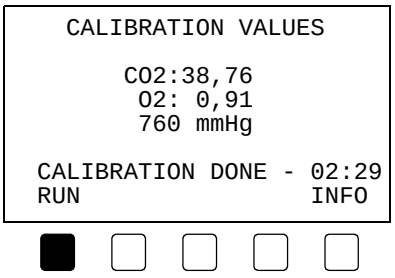
10 Press **PREV** (previous) to return to the CALIBRATION SETTINGS menu.

11 Press **START**. Calibration begins.

If **START** is not displayed, but **1pt** and **2pt** are, skip to “O2 Sensor Recalibration” on page 40.

The calibrator’s LOW GAS indicator lights and CALIBRATING LOW appears in the message center. Once the sensor stabilizes, the calibrator’s HIGH GAS indicator lights and CALIBRATING HIGH appears in the message center.

12 Calibration is complete when a beep sounds and CALIBRATION DONE appears.



Your values may differ from those shown here.

13 Press **RUN** to return to the main menu.
- or -
Press **INFO** to display the just completed LAST CALIBRATION, then press **RUN**.

> Pressing **RUN** resets the site timer. The timer value is briefly displayed.
>
> For 10 minutes after pressing **RUN**, limit alerts are suppressed. This allows the sensor to be applied to the patient and begin stabilizing without limit violations becoming a nuisance. To enable limit alerts prior to the 10 minute delay, press the key. The indicator turns off and alerts are enabled.

14 Remove the sensor from the calibrator.

The sensor is now properly calibrated and may be applied to the patient.

Manual Calibration of the O_2 Sensor

The Oxygen Sensor is unique in that it can be calibrated without the use of the Model 868 Calibrator by using “Zero Solution” and “Room Air”.

O_2 Sensor Initial Calibration

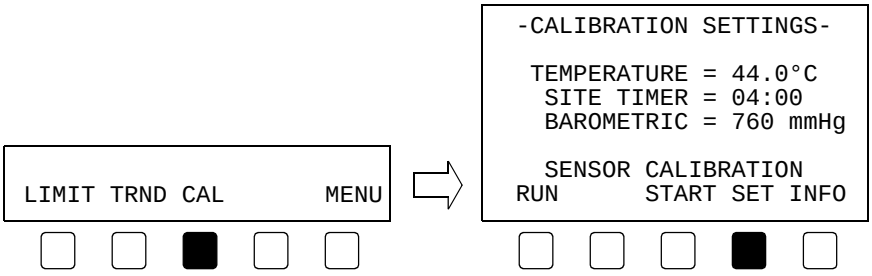
The Oxygen Sensor 6754-00 can be calibrated using Zero Solution (Cat. No. 8231) and “Room Air” in lieu of the Model 868 Transcutaneous Calibrator.

To initially calibrate the Oxygen Sensor 6754-00 using Zero Solution and room air:

1 Ensure the Oxygen Sensor 6754-00 is properly prepared and connected to the monitor, the monitor is turned on, and the sensor is at operating temperature.

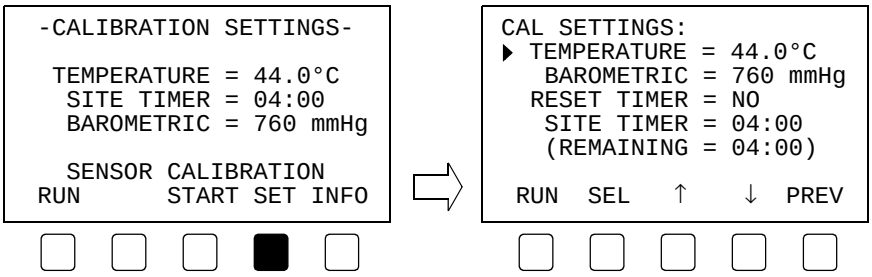
> Between site changes, clean the NOVADISK face (alcohol wipe) prior to placing in the calibrator. Lotions, skin oils or other residue may influence calibration.

2 Press the **CAL** softkey. The CALIBRATION SETTINGS menu appears.



3 Verify the setting for temperature and site timer are as desired and that the barometric pressure display is correct. If so, skip ahead to Step 8.

4 Press **SET** and the CAL SETTINGS menu appears.



5 Use the **SEL** key to move the selection triangle to highlight TEMPERATURE. Use the ↑ or ↓ keys select the desired temperature.

6 Use the **SEL** key to move the selection triangle to highlight SITE TIMER. Use the ↑ or ↓ keys select the desired timer duration.

7 Press **PREV** (previous) to return to the CALIBRATION SETTINGS menu.

8 Grasp a Zero Solution dispenser (PN: 8231) with the thumb and forefinger. Hold the dispenser upright and point the tip away from yourself. Squeeze the

dispenser so that the ampule inside the dispenser breaks. Once opened, the dispenser has a useful life of forty-eight hours.

9 Lightly tap the bottom of the dispenser on a hard surface so that the broken ampule pieces settle to the bottom.

10 Apply a drop of zero solution to the sensor face. Ensure that the solution covers the sensor cathode (dark spot in the center of the sensor face).

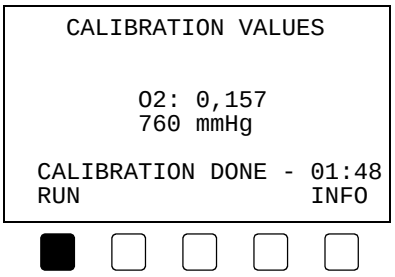
> CAUTION: Zero Solution must NOT be applied directly to the sensor face without a NOVADISK membrane assembly in place.

11 Press **START** from the CALIBRATION SETTINGS menu.

If **START** is not displayed, but **1pt** and **2pt** are, skip to "O2 Sensor Recalibration" on page 40.

12 CALIBRATING LOW appears on the display. As soon as CALIBRATING RM AIR appears, completely remove the Zero Solution from the sensor face using a tissue or gauze. (Do not leave Zero Solution on the membrane for longer than 3 minutes.)

13 Calibration is complete when a beep sounds and CALIBRATION DONE appears.



Your values may differ from those shown here.

14 Press **RUN** to return to the main menu.
- or -
Press **INFO** to display the just completed LAST CALIBRATION, then press **RUN**.

> Pressing **RUN** resets the site timer. The timer value is briefly displayed.
>
> For 10 minutes after pressing **RUN**, limit alerts are suppressed. This allows the sensor to be applied to the patient and begin stabilizing without limit violations becoming a nuisance. To enable limit alerts prior to the 10 minute delay, press the key. The indicator turns off and alerts are enabled.

15 The sensor is now properly calibrated and may be applied to the patient.

O_2 Sensor Recalibration

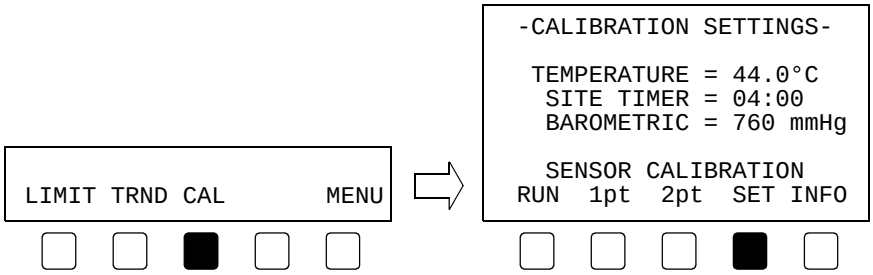
Once the Oxygen Sensor 6754-00 is calibrated using a two-point method (using Low and High Gas with a gas calibrator, or using Zero Solution and room air) subsequent recalibration of the sensor, as long as the sensor is not disconnected or the monitor

turned off, may be done using a one-point "High" calibration, again using High Gas and the calibrator or Room Air.

CAUTION: If a one-point recalibration is performed while the gas calibrator is connected to the *TCO_2M*, the monitor assumes the recalibration should take place in High Gas and not in room air. Therefore, if using the gas calibrator, place the sensor into the calibrator's Sensor Port before performing a one-point recalibration.

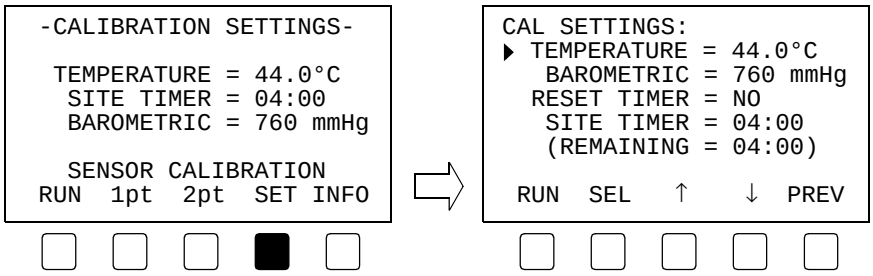
To recalibrate the Oxygen Sensor 6754-00 using a one-point calibration:

1 Press the **CAL** softkey. The CALIBRATION SETTINGS menu appears.



2 Verify the setting for temperature and site timer are as desired and that the barometric pressure display is correct. If so, skip ahead to Step 7.

3 Press **SET** and the CAL SETTINGS menu appears.



4 Use the **SEL** key to move the selection triangle to highlight TEMPERATURE. Use the ↑ or ↓ keys select the desired temperature.

5 Use the **SEL** key to move the selection triangle to highlight SITE TIMER. Use the ↑ or ↓ keys select the desired timer duration.

6 Press **PREV** (previous) to return to the CALIBRATION SETTINGS menu.

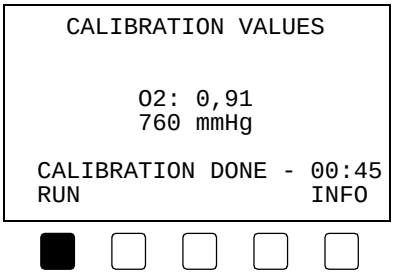
7 From the CALIBRATION SETTINGS menu press the **1pt** (one-point) key.

Pressing **2pt** (two-point) starts a calibration using Zero Solution and Room Air, or if the Calibrator is connected, a Low and High Gas calibration.

8 If CALIBRATING RM AIR appears ensure the sensor is exposed to room air. If CALIBRATING HIGH appears put the sensor into the Calibrator's Sensor Port.

Between site changes, clean the NOVADISK face (alcohol wipe) prior to placing in the calibrator. Lotions, skin oils or other residue may influence calibration.

9 Calibration is complete when a beep sounds and CALIBRATION DONE appears.



Your values may differ from those shown here.

10 Press **RUN** to return to the main menu.
- or -
Press **INFO** to display the just completed LAST CALIBRATION, then press **RUN**.

Pressing **RUN** resets the site timer. The timer value is briefly displayed.

For 10 minutes after pressing **RUN**, limit alerts are suppressed. This allows the sensor to be applied to the patient and begin stabilizing without limit violations becoming a nuisance. To enable limit alerts prior to the 10 minute delay, press the key. The indicator turns off and alerts are enabled.

11 The O_2 Sensor is now properly recalibrated and may be reapplied to the patient.

8 Apply Sensor to Patient

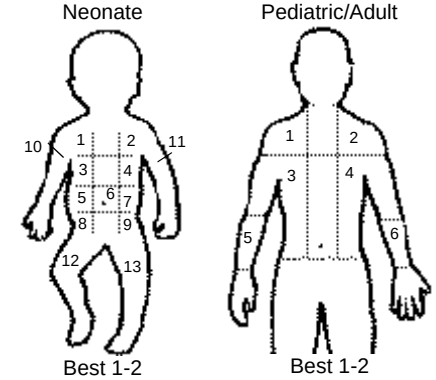
The section details the steps necessary to select an appropriate site for monitoring; how to apply the sensor to the site; and, how to remove the sensor from the site.

Sensor Site Selection

Optimal functioning of the transcutaneous monitoring system is dependent upon careful selection of the sensor site. Select a sensor site with good capillary blood flow where an airtight seal between the sensor and the skin may be maintained. Avoid areas with large amounts of fatty deposit or bony prominences which may constrict the blood flow beneath the surface of the sensor.

For neonates, the most commonly used sensor sites are the upper chest, abdomen and inner aspect of the thigh. If the infant is laying on his side or abdomen, the back is sometimes used. If the intended site is on an extremity, a restraint board may be used to stabilize the area.

Recommended skin sites for adult monitoring are the upper part of the chest and shoulder area. Alternate sites are the inner aspect of the arm, axillary area and upper back.



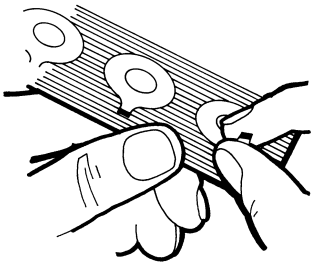
The skin at the site must be properly prepared. Lotions, skin oils, residue from adhesive rings or patches, etc., may impede the diffusion of oxygen and/or carbon dioxide from the skin to the sensor, or they may keep the adhesive ring from forming a good seal around the site. Clean and degrease the skin with soap and water and then wipe the area with an alcohol swab. If necessary shave the sensor site.

Sensor to Patient Application

Once the monitoring site has been selected and properly prepared, the sensor must be prepared for application to the patient. This section assumes that the sensor is ready for application (has been remembraned and calibrated).

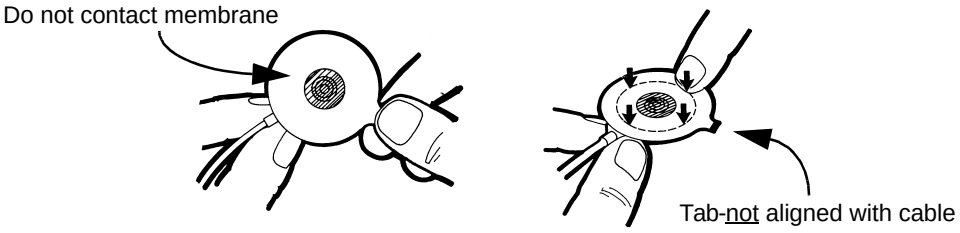
To apply the sensor to a patient:

1 Grasp a sensor adhesive ring PN:8285 or PN:8805 by the colored tab and peel it away from the paper backing strip.

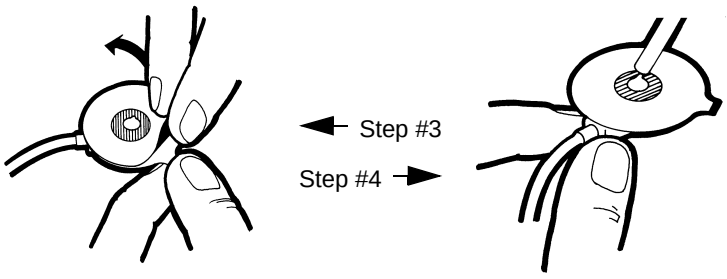


2 Attach the adhesive ring to a properly membraned and calibrated sensor by pressing the ring onto the NOVADISK membrane assembly.

Exercise care so that the adhesive ring does not touch the membrane (so the membrane does not get covered or torn). Removal of the sensor and adhesive ring will be easier if the colored tab *is not* aligned with the sensor cable.



3 Grasp the ring by the colored tab. Peel away the liner to expose the adhesive.

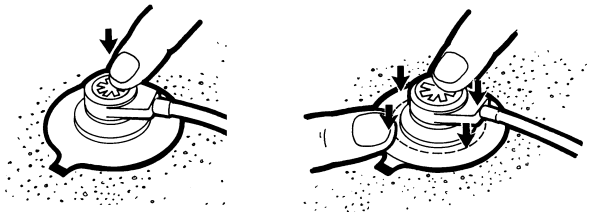


4 Place a drop of transcutaneous sensor contact gel, PN: 8888, onto the center of the sensor face.

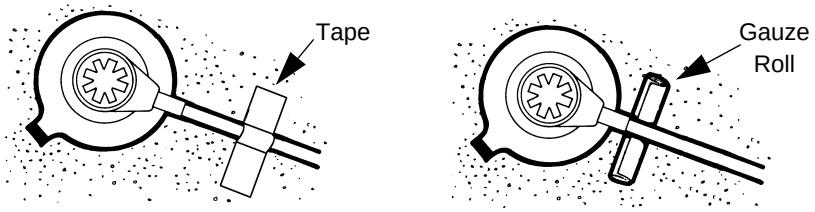
Note that deionized water may be substituted for contact gel if the application is limited to *short periods* of time and at *lower* temperatures (e.g., 2 hours at 43.5 degrees). Using water instead of contact gel may

improve response time but the membrane/skin interface will dry out more rapidly than with the gel.

5 Press the sensor into place on a properly prepared site. Firmly press the edges of the adhesive ring to the skin, ensuring an airtight seal between the skin and sensor.



6 Optionally, secure the sensor cable with tape at an appropriate distance from the sensor. In some cases, a rolled gauze pad under the cable close to the sensor may help minimize sensor movement.



WARNING: *The location of the sensor must be changed periodically to eliminate the risk of burns due to the heating of the skin by the sensor*. The risk of such a burn is dependent upon sensor temperature, duration of application, and several physiological parameters including, local perfusion, body temperature and skin thickness. Refer to “Site Timer” on page 33 for directions on using the *TCO_2M* site timer feature, and guidelines for site application times.

Removing the Sensor from the Patient

To remove the sensor from the skin:

1 Gently peel back the adhesive ring starting from the colored tab.

The adhesive may be loosened from the skin with water or alcohol prior to removal. Care should be taken not to loosen the NOVADISK membrane assembly. If the NOVADISK loosens from the sensor, the sensor must be remembraned with a new NOVADISK and recalibrated before the sensor is reapplied to the patient.

2 Wipe the face of the NOVADISK membrane clean and remove any adhesive ring residue with an alcohol wipe before calibrating/or storing.

9 Combination O_2/CO_2 Sensor

The Combination O_2/CO_2 Sensor (part number 4474-00 or 4474-39) discussed in this section allows the *TCO_2M* Transcutaneous Monitor, Model 860, to monitor $PtcCO_2$ and $PtcO_2$ levels simultaneously from a single sensor site. If using a different sensor type, refer to its specific instructions elsewhere in this manual.

Sensor Identification

The Combination O_2/CO_2 Sensor is available in two versions. ***Identify which type you will be using as they use different, non-compatible NOVADISK membranes and preparation procedures.*** The part number located on the cable identification tag near the cable connector identifies the sensor as a 4474-00 or 4474-39 type sensor.

(The 4474-00 sensor is a newer version with shorter stabilization after membraning. The 4474-39 sensor continues to be available so that facilities using this older sensor may benefit by maintaining only one type of sensor/membrane assembly.)

Sensor Construction

The Combination O_2/CO_2 Sensor, consists of a silver colored connector for attachment to the monitor, a white cable assembly, and a GRAY sensor assembly called the sensor head. To this GRAY sensor head is attached a NOVADISK membrane assembly that forms the patient-sensor interface.

Sensor Operation

A thin layer of electrolyte is placed between the NOVADISK membrane and the sensor head. Oxygen and carbon dioxide diffuse through the skin, across the contact gel layer between the skin and the membrane, across the membrane and into the electrolyte where they effect the electro-chemical processes of the sensor and cause values for CO_2 and O_2 to be displayed. Sensor calibrations correct for small changes in the electrolyte or the stretching/distorting the membrane that may occur during patient application, but after about a week, heat from the sensor starts to evaporate the electrolyte and the physical stresses on the thin membrane material require the NOVADISK to be replaced.

Membrane Schedule

Proper functioning of the transcutaneous gas monitoring system is dependent upon careful preparation and calibration of the sensor. The gray NOVADISK Premounted Membrane that connects to the sensor and forms the patient-sensor interface must be replaced under any of the following conditions:

- If there is more than 50% air in the annulus.
- If the membrane has been damaged or the NOVADISK has loosened from the sensor.

- After 7 days of use or after extended periods of non-use.

4474-00 Sensor Membraning Procedure

The procedure outlines the steps necessary to apply a Presoaked Split Membrane NOVADISK Premounted Membrane assembly (8900-00) to a 4474-00 Combination O_2/CO_2 Sensor.

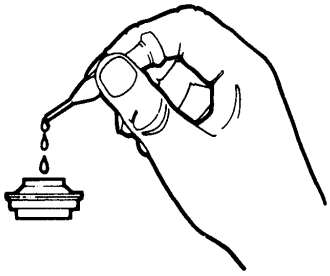
> If using a 4474-39 Combination O_2/CO_2 Sensor, refer to the following section.

To membrane the 4474-00 Combination sensor:

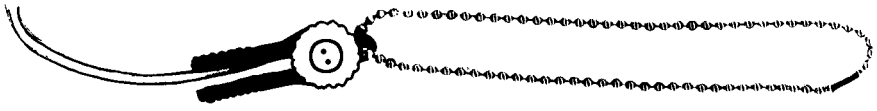
1 Peel open a Combination O_2/CO_2 Sensor Split Membrane NOVADISK kit, PN:8900, which includes a dark gray (darker gray than the sensor body) NOVADISK, a white capped electrolyte dispenser, and a cleaning swab.

2 Unscrew the white cap. Discard the cap and blue sealing washer. Leave the clear plastic cap and blue foam insert in place on the NOVADISK.

3 If needed, apply several drops of electrolyte onto the membrane (enough electrolyte to coat the membrane).

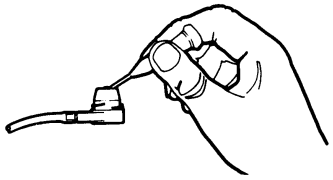


4 Place the sensor into the black sensor wrench. Unscrew the old NOVADISK from the sensor and discard. Do not reuse the NOVADISK.

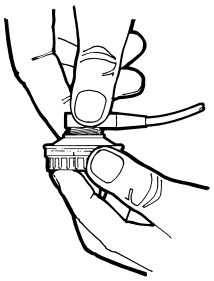


5 Rinse the sensor face with several drops of electrolyte. Allow the electrolyte rinse to drip off the sensor face. *Do not wipe sensor face with tissue or gauze.*

6 With the sensor upright, apply a generous amount electrolyte from the dispenser to the face of the sensor. Ensure that the fluid fills the annulus.

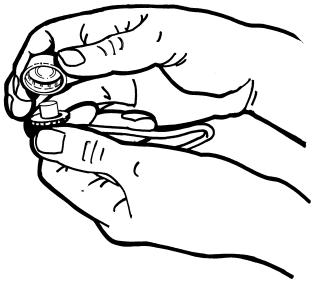


7 Invert the sensor into the NOVADISK and tighten the NOVADISK securely. Excess electrolyte will be displaced out of the NOVADISK through the small vent hole.



8 Wipe the excess electrolyte from the sensor and NOVADISK with a tissue or gauze.

9 Remove the clear protective plastic cap and the blue foam insert from the NOVADISK. *Do not use a twisting motion when removing the plastic cap.* Discard the foam insert. Retain the cap to protect the membrane when the sensor is not in use.



10 Inspect the sensor face for membrane conformity and entrapped air. If the annulus is filled with more than 50% air, a *new* membrane must be applied.

11 Allow the sensor to stabilize at operating temperature for at least 1/2 hour to ensure minimal sensor drift and optimal performance.

> If at any time the NOVADISK assembly loosens from the sensor, the entire membrane application procedure must be repeated using a *new* membrane assembly kit.

12 The 4474-00 sensor is now ready for calibration.

Long Term Combination Sensor Storage

The Combination O_2/CO_2 Sensor must be stored with electrolyte in contact with the sensor face. Therefore, before storage, follow the appropriate preparation procedure (for 4474-00 or 4474-39 sensors). If the Combination O_2/CO_2 Sensor is allowed to dry out, the cleaning procedure should be followed prior to the preparation of the sensor with a new membrane. If the sensor has not been used for an extended period of time, the stabilization time after re-membraning may be up to 24 hours.

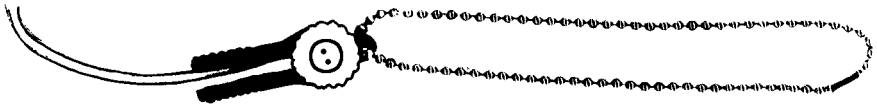
Cleaning the Combination Sensor face

If the Combination O_2/CO_2 Sensor exhibits poor O_2 performance, including O_2 calibration errors or slow or erratic O_2 response that is not corrected by applying a new NOVADISK membrane, the O_2 portion (and NOT the CO_2 portion) of the sensor face should be cleaned. The cleaning procedure applies to both the 4474-00 and 4474-39 sensors.

> It should not be necessary to clean the sensor more frequently than once each 3 to 5 weeks. The sensor may exhibit CO_2 drift of more than 2 mmHg per hour for as long as 8 hours after cleaning. The sensor may also exhibit artificially high O_2 readings in the presence of Nitrous Oxide for the first 24 hours of use after cleaning.

To clean the O_2 portion of the Combination O_2/CO_2 Sensor:

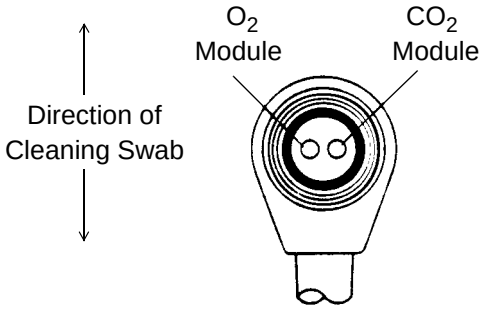
1 Place the sensor into the black sensor wrench. Unscrew the old NOVADISK from the sensor and discard. Do not reuse the NOVADISK.



2 Peel open a Combination O_2/CO_2 Sensor NOVADISK kit, (PN: 8900 if using a 4474-00 sensor, PN: 8575 if using a 4474-39 sensor) and a remove the cleaning swab.

3 Moisten the swab (it is coated with a cleaning abrasive) using only Sterile Water for Injection U.S.P., deionized or distilled water. (Do not use Sterile Water for Feeding or Irrigation as these may contain added impurities).

4 Rub the swab briskly across the O_2 module on the sensor face approximately 12 times rotating the swab 90 degrees every 3 strokes. *Avoid rubbing the CO_2 module in order to minimize CO_2 destabilization*.



5 Thoroughly flush the sensor face using only Sterile Water for Injection U.S.P., deionized or distilled water. Ensure that all debris is flushed away.

6 Dry the face of the sensor with a tissue or gauze. Ensure that the sensor face has been thoroughly dried and is free of debris. Do not touch the sensor face once it has been cleaned.

7 The sensor is now ready for membrane application. Reference the appropriate membrane application procedure (4474-00 or 4474-39). Allow an extra 1 hour for stabilization of a newly cleaned sensor. (If the sensor has not been used for an extended period of time, the stabilization time may be up to 24 hours.)

4474-39 Sensor Membraning Procedure

The procedure outlines the steps necessary to apply a NOVADISK Premounted Membrane assembly (8575-00) to a 4474-39 Combination O_2/CO_2 Sensor.

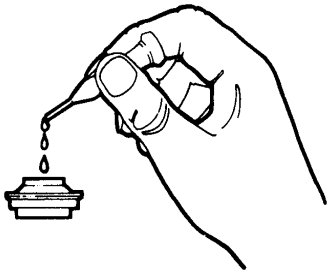
If using a 4474-00 Combination O_2/CO_2 Sensor, refer to the previous section.

To membrane the 4474-39 Combination sensor:

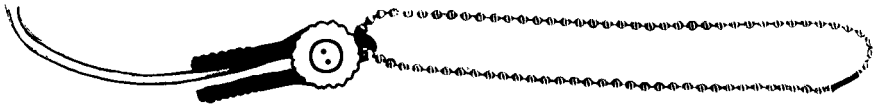
1 Peel open a Combination O_2/CO_2 Premounted Membrane NOVADISK kit, PN:8575, which includes a gray NOVADISK (same gray as the sensor body), a white capped electrolyte dispenser, and a cleaning swab.

2 Unscrew the white cap and discard. Leave the clear plastic cap and blue foam insert in place on the NOVADISK.

3 Apply several drops of electrolyte onto the membrane in the NOVADISK (enough to coat the membrane). Allow the electrolyte to soak the membrane for 20 minutes.

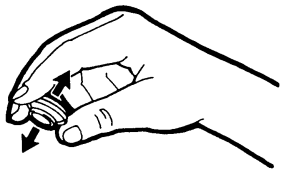


4 Place the sensor into the black sensor wrench. Unscrew the old NOVADISK from the sensor and discard. Do not reuse the NOVADISK.



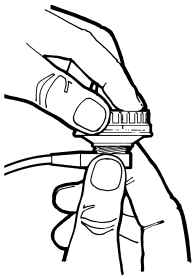
5 Rinse the sensor face with several drops of electrolyte. Allow the electrolyte rinse to drip off the sensor face. *Do not wipe sensor face with tissue or gauze.*

6 Remove excess electrolyte from the soaking NOVADISK by shaking upside down.



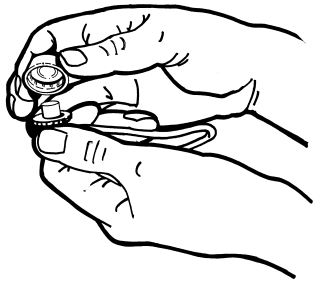
7 With the sensor upright, apply a generous amount electrolyte from the dispenser to the face of the sensor. Ensure that the fluid fills the annulus.

8 Secure the NOVADISK assembly to the sensor. Apply firm pressure from the NOVADISK to the sensor then slowly rotate the NOVADISK clockwise until secure.



9 Wipe the excess electrolyte from the sensor and NOVADISK with a tissue or gauze.

10 Remove the clear protective plastic cap and the blue foam insert from the NOVADISK. *Do not use a twisting motion when removing the plastic cap.* Discard the foam insert. Retain the cap to protect the membrane when the sensor is not in use.



11 Inspect the sensor face for membrane conformity and entrapped air. If the annulus is filled with more than 50% air, a *new* membrane must be applied.

12 Allow the sensor to stabilize at operating temperature for at least 2 hours to ensure minimal sensor drift and optimal performance.

> If at any time the NOVADISK assembly loosens from the sensor, the entire membrane application procedure must be repeated using a *new* membrane assembly kit.

13 The 4474-00 sensor is now ready for calibration.

10 Carbon Dioxide Sensor

The Carbon Dioxide Sensor (6752-00) discussed in this section allows the *TCO_2M* Transcutaneous Monitor, Model 860, to monitor PtcCO_2. If using a different sensor type, refer to its specific instructions elsewhere in this manual.

CO_2 Sensor Construction

The Carbon Dioxide Sensor, consists of a silver colored connector for attachment to the monitor, a white cable assembly, and a BLUE sensor assembly called the sensor head. To this BLUE sensor head is attached a NOVADISK membrane assembly that forms the patient-sensor interface. The sensor part number located on the identification tag near the cable connector.

CO_2 Sensor Operation

A thin layer of electrolyte is placed between the NOVADISK membrane and the sensor head. Carbon dioxide diffuses through the skin, across the contact gel layer between the skin and the membrane, across the membrane and into the electrolyte where it effects the electro-chemical processes of the sensor and causes a values for CO_2 to be displayed. Sensor calibrations correct for small changes in the electrolyte or the stretching/distorting the membrane that may occur during patient application, but after about a week, heat from the sensor starts to evaporate the electrolyte and the physical stresses on the thin membrane material require the NOVADISK to be replaced.

Membrane Schedule

Proper functioning of the transcutaneous gas monitoring system is dependent upon careful preparation and calibration of the sensor. The blue NOVADISK Premounted Membrane that connects to the sensor and forms the patient-sensor interface must be replaced under any of the following conditions:

- If there is more than 50% air in the annulus.
- If the membrane has been damaged or the NOVADISK has loosened from the sensor.
- After 7 days of use or after extended periods of non-use.

CO_2 Sensor Membraning Procedure

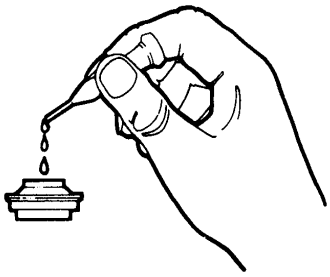
The procedure outlines the steps necessary to apply a NOVADISK Premounted Membrane assembly (8383-00) to a 6752-00 Carbon Dioxide Sensor.

To membrane the 6752-00 Carbon Dioxide Sensor:

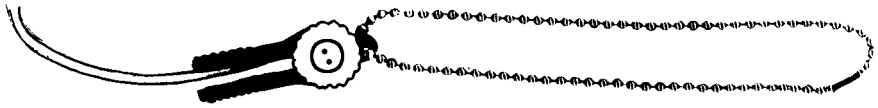
1 Peel open a CO_2 Premounted Membrane NOVADISK kit, PN:8383, which includes a blue NOVADISK and a blue capped electrolyte dispenser.

2 Unscrew the white cap and discard. Leave the clear plastic cap and blue foam insert in place on the NOVADISK.

3 Apply several drops of electrolyte onto the membrane in the NOVADISK (enough to coat the membrane). Allow the electrolyte to soak the membrane for 20 minutes.

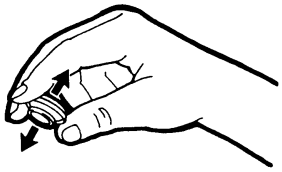


4 Place the sensor into the black sensor wrench. Unscrew the old NOVADISK from the sensor and discard. Do not reuse the NOVADISK.

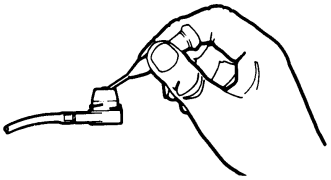


5 Rinse the sensor face with several drops of electrolyte. Allow the electrolyte rinse to drip off the sensor face. *Do not wipe sensor face with tissue or gauze.*

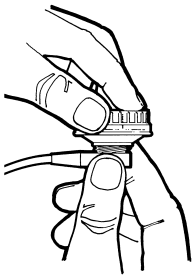
6 Remove excess electrolyte from the soaking NOVADISK by shaking upside down.



7 With the sensor upright, apply a generous amount electrolyte from the dispenser to the face of the sensor. Ensure that the fluid fills the annulus.

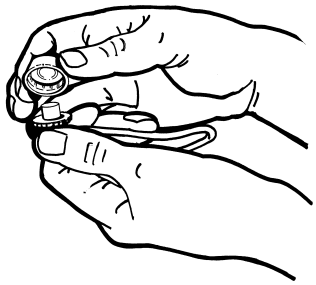


8 Secure the NOVADISK assembly to the sensor. Apply firm pressure from the NOVADISK to the sensor then slowly rotate the NOVADISK clockwise until secure.



9 Wipe the excess electrolyte from the sensor and NOVADISK with a tissue or gauze.

10 Remove the clear protective plastic cap and the blue foam insert from the NOVADISK. *Do not use a twisting motion when removing the plastic cap.* Discard the foam insert. Retain the cap to protect the membrane when the sensor is not in use.



11 Inspect the sensor face for membrane conformity and entrapped air. If the annulus is filled with more than 50% air, a *new* membrane must be applied.

12 Allow the sensor to stabilize at operating temperature for at least 1 hour to ensure minimal sensor drift and optimal performance.

> If at any time the NOVADISK assembly loosens from the sensor, the entire membrane application procedure must be repeated using a *new* membrane assembly kit.

13 The 6752-00 sensor is now ready for calibration.

Long Term CO_2 Sensor Storage

The Carbon Dioxide Sensor must be stored with electrolyte in contact with the sensor face. Therefore, before storage, follow the membrane preparation procedure. If the sensor is allowed to dry out, the cleaning procedure should be followed prior to the preparation of the sensor with a new membrane. If the sensor has not been used for an extended period of time, the stabilization time after re-membraning may be up to 24 hours.

Cleaning the CO_2 Sensor face

The CO_2 sensor face does not require any routine cleaning.

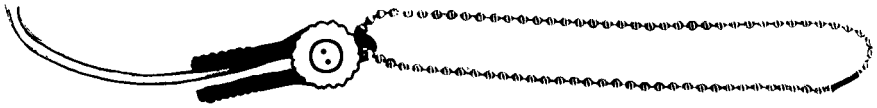
The sensor face should be cleaned *only* under the following conditions:

- Suspected contamination of the sensor face.
- Excessive drift of the PtcCO_2 system.
- Inability to stabilize CO_2 values in calibration gasses.

To clean the Carbon Dioxide Sensor:

CAUTION: Do not polish the face of the CO_2 sensor. Polishing the CO_2 sensor will cause permanent non-warrantied damage. (The brown coating on CO_2 sensor face should not be removed. This coating may lighten with age or bright light but the color change will not effect the operation of the sensor.)

1 Place the sensor into the black sensor wrench. Unscrew the old NOVADISK from the sensor and discard. Do not reuse the NOVADISK.



2 Thoroughly flush the sensor face using only Sterile Water for Injection U.S.P., deionized or distilled water. (Do not use Sterile Water for Feeding or Irrigation as these may contain added impurities.) Ensure that all debris is flushed away.

3 Dry the face of the sensor with a tissue or gauze. Ensure that the sensor face has been thoroughly dried and is free of debris. Do not touch the sensor face once it has been cleaned.

4 The sensor is now ready for membrane application. Refer to the membrane application procedure above. Allow an extra 1-2 hours for stabilization of a newly cleaned sensor. (If the sensor has not been used for an extended period of time, the stabilization time may be up to 24 hours.)

11 Oxygen Sensor

The Oxygen Sensor (6754-00) discussed in this section allows the *TCO_2M* Transcutaneous Monitor, Model 860, to monitor $PtcO_2$. If using a different sensor type, refer to its specific instructions elsewhere in this manual.

O_2 Sensor Construction

The Oxygen Sensor, consists of a silver colored connector for attachment to the monitor, a white cable assembly, and a GREEN sensor assembly called the sensor head. To this GREEN sensor head is attached a NOVADISK membrane assembly that forms the patient-sensor interface. The sensor part number located on the identification tag near the cable connector.

O_2 Sensor Operation

A thin layer of electrolyte is placed between the NOVADISK membrane and the sensor head. Oxygen diffuses through the skin, across the contact gel layer between the skin and the membrane, across the membrane and into the electrolyte where it effects the electro-chemical processes of the sensor and causes a value for O_2 to be displayed. Sensor calibrations correct for small changes in the electrolyte or the stretching/ distorting the membrane that may occur during patient application, but after about a week, heat from the sensor starts to evaporate the electrolyte and the physical stresses on the thin membrane material require the NOVADISK to be replaced.

Membrane Schedule

Proper functioning of the transcutaneous gas monitoring system is dependent upon careful preparation and calibration of the sensor. The green NOVADISK Premounted Membrane that connects to the sensor and forms the patient-sensor interface must be replaced under any of the following conditions:

- If there is more than 50% air in the annulus.
- If the membrane has been damaged or the NOVADISK has loosened from the sensor.
- After 7 days of use or after extended periods of non-use.

Cleaning and Membraning the O_2 Sensor face

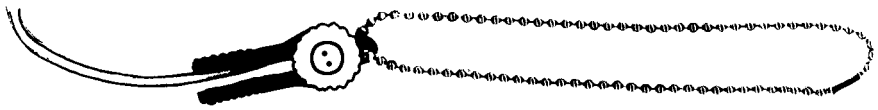
The oxygen sensing portion of the Oxygen Sensor should be cleaned prior to each new membrane application.

To clean the 6754-00 Oxygen Sensor:

1. Peel open a Oxygen Sensor Membrane NOVADISK kit, PN:8286, which includes a dark green NOVADISK, a green capped electrolyte dispenser, and

a small white cleaning pad glued to the plastic tray. Remove and set aside the NOVADISK and electrolyte dispenser.

2 Place the sensor into the black sensor wrench. Unscrew the old NOVADISK from the sensor and discard. Do not reuse the NOVADISK.



3 Moisten the white cleaning material on the plastic tray using only Sterile Water for Injection U.S.P., deionized or distilled water. (Do not use Sterile Water for Feeding or Irrigation as these may contain added impurities.).

4 Applying light pressure, rub the face of the sensor in a circular motion on the cleaning pad for 10 seconds.

5 Thoroughly flush the sensor face clean.

6 Dry the face of the sensor with a tissue or gauze. Ensure that the sensor face has been thoroughly dried and is free of debris. Do not touch the sensor face once it has been cleaned.

7 The sensor is now ready for membrane application.

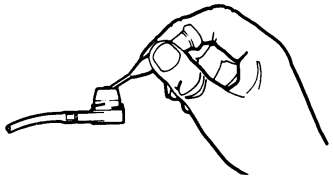
The procedure below outlines the steps necessary to apply a NOVADISK Premounted Membrane assembly (8286-00) to a 6754-00 Oxygen Sensor.

To membrane the 6754-00 Oxygen Sensor:

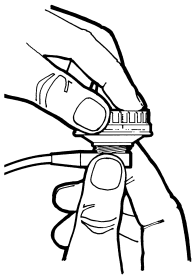
1 Retrieve the membrane assembly and electrolyte dispenser from the Oxygen Sensor Membrane NOVADISK kit, PN:8286, opened during the cleaning process (above).

2 Unscrew the white cap and discard. Leave the clear plastic cap and blue foam insert in place on the NOVADISK.

3 With the sensor upright, apply a generous amount electrolyte from the dispenser to the face of the sensor. Ensure that the fluid fills the annulus.

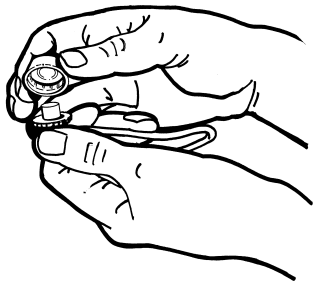


4 Secure the NOVADISK assembly to the sensor. Apply firm pressure from the NOVADISK to the sensor then slowly rotate the NOVADISK clockwise until secure.



5 Wipe any excess electrolyte from the sensor and NOVADISK with a tissue or gauze.

6 Remove the clear protective plastic cap and the blue foam insert from the NOVADISK. *Do not use a twisting motion when removing the plastic cap.* Discard the foam insert. Retain the cap to protect the membrane when the sensor is not in use.



7 Inspect the sensor face for membrane conformity and entrapped air. If the annulus is filled with more than 50% air, a *new* membrane must be applied.

8 Allow the sensor to stabilize at operating temperature for 20-30 minutes to ensure minimal sensor drift and optimal performance.

> If at any time the NOVADISK assembly loosens from the sensor, the entire membrane application procedure must be repeated using a *new* membrane assembly kit.

9 The 6754-00 Oxygen Sensor is now ready for calibration.

Long Term O_2 Sensor Storage

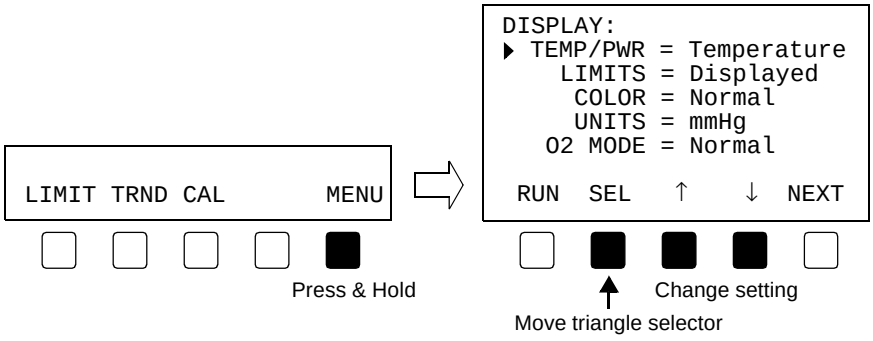
The Oxygen sensor requires no special handling prior to long term storage.

12 Advanced Controls and Features

The *TCO$_2$M* menu structure is divided into two parts; the User and Advanced menus. The User menu includes basic menu commands needed to operate the monitor on a daily basis. The Advanced menu contains setup/configuration commands that affect how the system operates, but that are typically not used in everyday monitoring. The User menu commands are detailed in "Menu Operation and Setup" on page 21. The Advanced menu commands are detailed below.

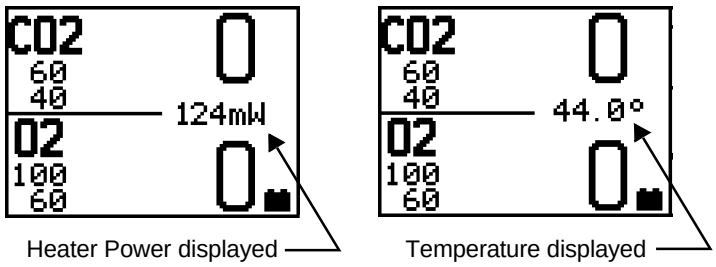
Display Menu

The Display Menu allows configuration of display related items. To access the DISPLAY menu, press and hold the **MENU** softkey for three seconds.



Temperature or Power Display

When using a Combination O_2/CO_2 Sensor with the alert limit values displayed, the screen only has room to display the sensor temperature or heater power value. (If the limits are hidden or a single parameter sensor is used, then both temperature and heater power will be displayed).

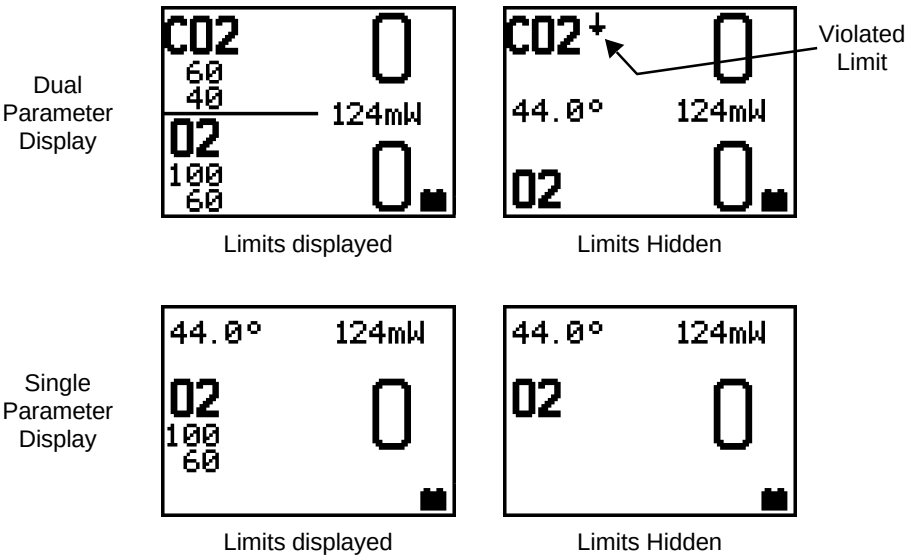


To select either temperature or power display:

1. From the base menu press and hold **MENU** until the DISPLAY menu appears.
2. The TEMP/PWR option should be selected, if not use the **SEL** key to select it.
3. Use the ↑ and ↓ (up/down arrows) to select Temperature or Heater Power.
4. Press **RUN** to return to the base menu.

Limit Display

The *TCO_2M* normally displays both high and low limits for $PtcCO_2$ and $PtcO_2$. If desired these limit values can be hidden. If a limit violation occurs while the limits are hidden, an ↑ or ↓ (up or down arrow) flashes beside the CO2 or O2 parameter display indicator (normally the violated limit would flash).



To change the limit display:

1. From the base menu press and hold **MENU** until the DISPLAY menu appears.
2. Press **SEL** to select LIMITS.
3. Use the ↑ and ↓ (up/down arrows) to select either Hidden or Displayed.
4. Press **RUN** to return to the base menu.

Display Colors

The *TCO_2M* display can be displayed set to one of three display formats.

1. From the base menu press and hold **MENU** until the DISPLAY menu appears.
2. Press **SEL** to select COLOR.
3. Use the ↑ and ↓ (up/down arrows) to select Normal, Blue or White.

Normal - blue text on white background and white trend in blue field
White - blue text on white background and blue trend in white field
Blue - white text on blue background and white trend in blue field

4 Press **RUN** to return to the base menu.

Display Units

The *TCO$_2$M* can display PtcCO$_2$ and PtcO$_2$ in mmHg or kPa units.
NOTE: All trend information will be erased when the display units are changed.

To change the display units:

1 From the base menu press and hold **MENU** until the DISPLAY menu appears.

2 Press **SEL** to select UNITS.

3 Use the ↑ and ↓ (up/down arrows) to select mmHg or kPa.

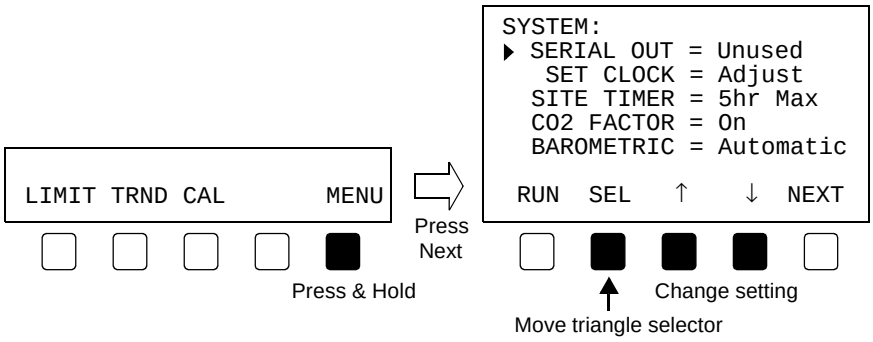
4 The monitor will prompt UNIT CHANGE ERASES TREND.
Press **CONT** to continue or **CANCEL** to cancel.

NOTE: All trend information will be erased when the display units are changed.

5 Press **RUN** to return to the base menu.

System Menu

Items in the System Menu affect how the *TCO$_2$M* operates. To access the SYSTEM menu, press and hold the **MENU** key until the DISPLAY menu appears, then press **NEXT.**



Serial Out

Various devices can be connected to the rear panel connector on the *TCO$_2$M*. In order to function properly the correct device must be identified in the interfaces menu. See “External Devices” on page 73 for more information on the peripherals that can be used with the *TCO$_2$M*.

To select an interface device:

1 From the base menu press and hold **MENU** until the DISPLAY menu appears.

2 Press **NEXT** to display the SYSTEM menu.

3 Press **SEL** to select SERIAL OUT.

4 Use the ↑ and ↓ (up/down arrows) to select a device.

5 Press **RUN** to return to the base menu.

Set Clock

The *TCO_2M* contains an internal real time clock for time stamping data in trend memory. The user can adjust the date and time.

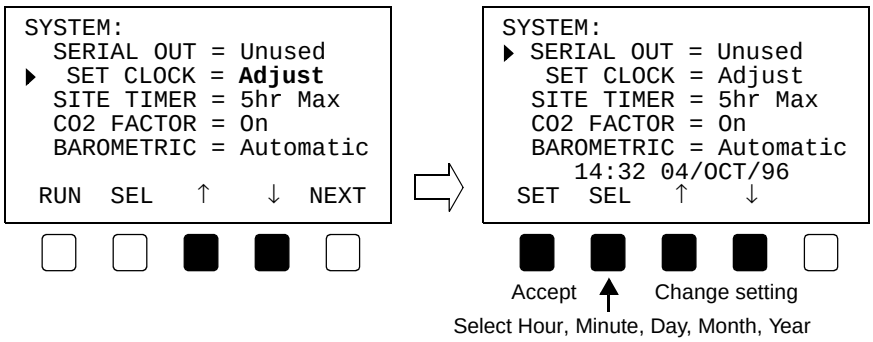
To set the time and date:

1 From the base menu press and hold **MENU** until the DISPLAY menu appears.

2 Press **NEXT** to display the SYSTEM menu.

3 Press **SEL** to select SET CLOCK.

4 Press the ↑ or ↓ (up/down arrow) key to display the time and date setting.



5 Edit the flashing parameter by using the ↑ or ↓ keys.
Move to the next parameter by pressing **SEL**.

Select the hour, minutes, day, month, then year for editing by using the **SEL** softkey. The selected parameter will flash, adjust the value using the up/down arrow key. The time is set up in the 24 hour format, so that 2:00 p.m. would be set as 14:00. When all is correct press **SET** to accept the current display.

6 Press **SET** to accept the new time and date setting.

7 Press **RUN** to return to the base menu.

Site Timer (Maximum Duration)

The *TCO_2M* has a site timer feature to remind the user to change the sensor site. The maximum site duration can be adjusted to 5, 8, or 12 hours.

> *WARNING: The location of the sensor must be changed periodically to eliminate the risk of skin damage due to the heating of the skin by the sensor.* Risk of such skin damage depends on sensor temperature, duration of application, and physiological parameters including local perfusion, body temperature and skin thickness.

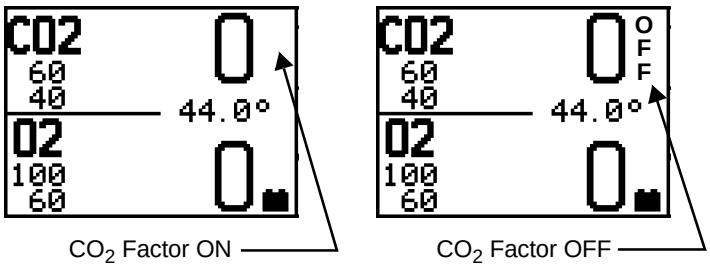
Generally, for neonates, the sensor site should be changed every 2-4 hours when using a temperature of 44° C, and every 4-6 hours at a sensor temperature of 43° C. For adults, the sensor site should be changed every 4-6 hours when using a temperature of 44° C. *Note that these times are guidelines only. The user should verify the duration for each patient.*

To adjust the maximum site duration:

1. From the base menu press and hold **MENU** until the DISPLAY menu appears.
2. Press **NEXT** to display the SYSTEM menu.
3. Press **SEL** to select SITE TIMER.
4. Use the ↑ and ↓ (up/down arrows) to select a 5, 8 or 12 hour maximum duration.
5. Press **RUN** to return to the base menu.

Metabolic Correction Factor

The CO_2 display reading is factory set to reflect the metabolic factor for pCO_2. The value is corrected only during patient monitoring, not during calibration. If the $ptcCO_2$ metabolic factor feature has been disabled, "OFF" will flash to the right of the current CO_2 value. Refer to "PtcCO2 Display Values" on page 19.



To enable or disable the $PtcCO_2$ metabolic factor:

1. From the base menu press and hold **MENU** until the DISPLAY menu appears.
2. Press **NEXT** to display the SYSTEM menu.
3. Press **SEL** to select CO2 FACTOR.
4. Use the ↑ and ↓ (up/down arrows) to select ON or OFF.
5. Press **RUN** to return to the base menu.

Barometric pressure determination

The *TCO_2M* normally uses its built-in sensor to automatically determine the barometric pressure at the time of sensor calibration. The pressure compensation can be set to automatic or manual. If set to manual, the CAL SETTINGS menu allows the user to select a barometric pressure setting for sensor calibration.

To select automatic or manual barometric pressure determination:

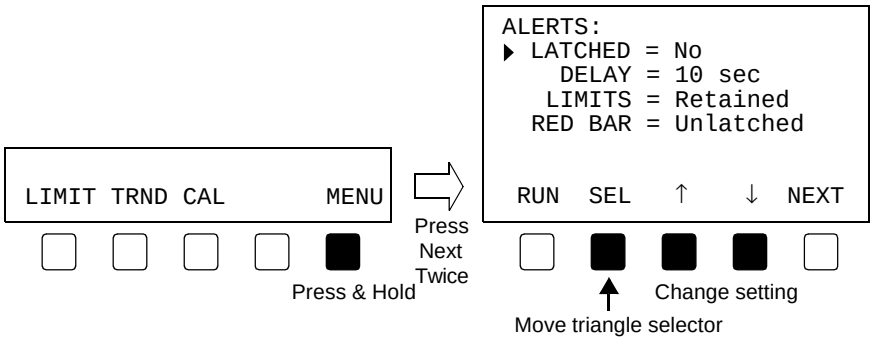
1. From the base menu press and hold **MENU** until the DISPLAY menu appears.
2. Press **NEXT** to display the SYSTEM menu.
3. Press **SEL** to select BAROMETRIC.
4. Use the ↑ and ↓ (up/down arrows) to select Automatic or Manual.

   Automatic sets the pressure to the nearest mmHg.

   Manual allows the user to select a pressure of 560-800 mmHg, in 5 mmHg steps, from the CAL SETTINGS portion of the Calibration menu.
5. Press **RUN** to return to the base menu.

Alerts Menu

The Alerts Menu allows configuration of alert related items. The ALERTS menu is accessed from the base menu by pressing and holding the **MENU** softkey until the DISPLAY menu appears, then pressing the **NEXT** softkey twice.



Latch Alerts

The *TCO_2M* will generate both audible and visual alerts when a limit alert condition is present. When the alert condition is corrected, the monitor will stop the audible alert and can either stop the visual alerts (Unlatched) or continue to let them flash (Latched) in which case they will only stop flashing when the ALERT RESET key is pressed. (Note that the Red Alert Bar can be unlatched from the other visual alerts (it stops with the audio) or latched to the visual alerts (it keeps flashing as lomng as they do).

To select Latched or Unlatched visual alerts;

1. From the main menu press and hold the **MENU** softkey until the DISPLAY menu appears. Press **NEXT** twice to display the ALERTS menu.
2. Press **SEL** to select LATCHED.
3. Use the up/down arrow keys to select **YES** or **NO** as desired.

   NO - visual alerts cease when the alert condition is no longer present.

   YES - visual alerts continue to flash (even after the violation is corrected) until the ALERT RESET key is pressed.
4. Press **RUN** to return to the base menu.

10 second Alert Delay Option

The monitor can be configured so that when a limit alert occurs, the alerts (audible and red alert bar) activate immediately or are delayed for 10 seconds. If the alerts are delayed and during the 10 second delay the parameter returns within limits, no alert is generated. This delay option may help prevent nuisance alerts when a parameter is hovering near a limit setting.

1. From the base menu press and hold **MENU** until the DISPLAY menu appears.
2. Press **NEXT** twice to display the ALERTS menu.
3. Press **SEL** to select DELAY.
4. Use the ↑ and ↓ (up/down arrows) to select 10 sec or None.
5. Press **RUN** to return to the base menu.

Retain Alert Limits

The *TCO_2M* can power up using the monitor's default limit settings (CO_2 60-40, O_2 100-60), or using limit values retained from the previous monitoring session.

1. From the base menu press and hold **MENU** until the DISPLAY menu appears.
2. Press **NEXT** twice to display the ALERTS menu.
3. Press **SEL** to select LIMITS.
4. Use the ↑ and ↓ (up/down arrows) to select Retained or Use Default.
5. Press **RUN** to return to the base menu.

Red Alert Bar

The red alert bar can be set to;

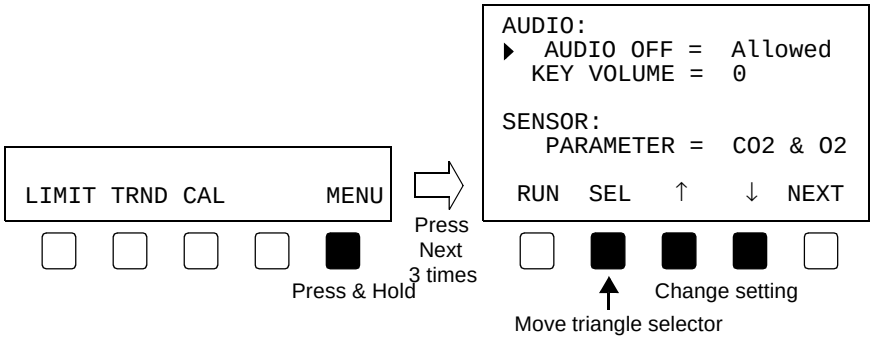
- Latched—where the alert bar remains flashing after the alert condition no longer exists and is only reset by pressing the ALERT RESET key
- Unlatched—where the alert bar stops flashing without user intervention once the once the alert condition clears
- Off—where the alert bar never illuminates.

1. From the base menu press and hold **MENU** until the DISPLAY menu appears.
2. Press **NEXT** twice to display the ALERTS menu.
3. Press **SEL** to select RED BAR.
4. Use the ↑ and ↓ (up/down arrows) to select Unlatched, Latched, or Off.

   Latched: Alert bar latched to limit alert conditions (flashes until **ALERT RESET**)
   Unlatched: Alert bar is not latched (stops flashing when alert ceases)
   Off: Disables the alert bar all together.
5. Press **RUN** to return to the base menu.

Audio Menu

The audio menu allows configuration of audio related options. The AUDIO menu is accessed from the base menu by pressing and holding the **MENU** softkey for three seconds until the DISPLAY menu appears, then pressing the **NEXT** softkey three times.



Allow Audio Off

The Audio Off feature can be disabled if desired. If disabled, the user cannot use the Audio Off feature to permanently prevent audible alerts; instead an AUDIO OFF DISABLED message is briefly displayed. Operation of the two minute silence is not affected.

To select the alert audio off option:

1. From the base menu press and hold **MENU** until the DISPLAY menu appears.
2. Press **NEXT** three times to display the AUDIO menu.
3. Use the ↑ and ↓ (up/down arrows) to select Allowed or Disabled.

   Allowed - the [🔔] will allow the audible alert to be permanently silenced.

   Disabled - the audible alert cannot be permanently silenced, only the two minute silence will work.
4. Press **RUN** to return to the base menu.

Keyclick Volume

The *TCO_2M* can produce a "keyclick" when any of the front panel keys are pressed (except the [½] key). The user can select the volume of this click or disable it by setting the key click volume to 0.

To adjust the keyclick volume:

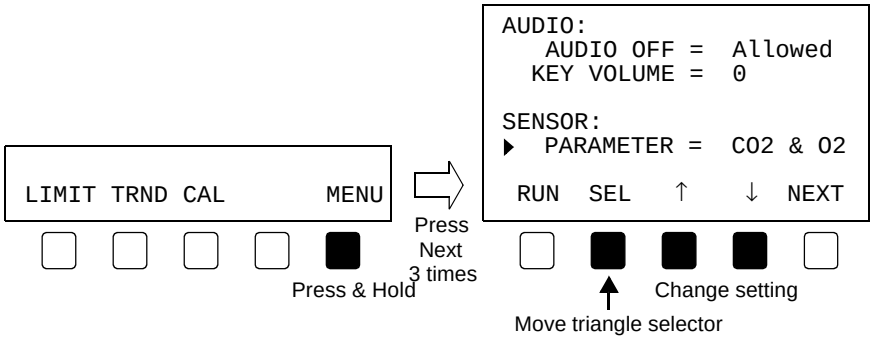
1. From the base menu press and hold **MENU** until the DISPLAY menu appears.
2. Press **NEXT** three times to display the AUDIO menu.
3. Press **SEL** to select KEY VOLUME.
4. Use the ↑ and ↓ (up/down arrows) to select the desired volume.

Setting the keyclick volume to 0 will mute the keyclick (off), likewise setting the volume to 7 is the loudest setting. The monitor will retain the setting even when power is cycled.

5 Press **RUN** to return to the base menu.

Sensor Menu

The sensor menu lets you choose to use one or both parameters of a Combination O_2/CO_2 Sensor. (In some situations, you may only want to monitor a single parameter from a Combination Sensor. This feature lets you do it.) If using a single parameter sensor, this menu has no effect. The SENSOR menu is accessed from the base menu by pressing and holding the **MENU** softkey for three seconds until the DISPLAY menu appears, then pressing the **NEXT** softkey three times.



To select which parameters of a Combination Sensor to monitor;

1 From the base menu press and hold **MENU** until the DISPLAY menu appears.

2 Press **NEXT** three times to display the SENSOR menu.

3 Press **SEL** to select PARAMETER.

4 Use the ↑ and ↓ (up/down arrows) to select CO_2 & O_2, CO_2 only, or O_2 only.

5 Press **RUN** to return to the base menu.

Restoring factory defaults settings

The *TCO_2M* retains measurement parameters and system setup information in its memory even if the monitor is turned off. These retained settings are restored at power up and will remain in effect until changed by the user.

To return the monitor to its factory default settings;

1 Turn the monitor off.

2 Turn the monitor on while pressing the **ALERT RESET** key.

3 The message Parameters Reset To Factory Default is briefly displayed and the default values are restored.

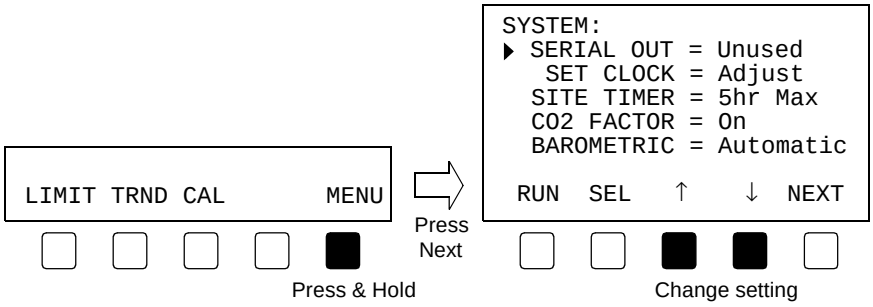
13 External Devices

The *TCO$_2$M* has a built-in RS232 data communications port. The *TCO$_2$M* can interface with the *NovaCARD* writer module, the Novametrix Analog Output Module, Novametrix specified printer (DPU-411), *NovaCOM* (full featured computer interface), Spacelabs Flexport, and supports a configurable Terminal mode. The data communications port is electrically isolated from the patient connected circuitry.

The *TCO$_2$M* communications port must be configured for the type of device being used. This is done in the SYSTEM menu. If none of the available devices are being used the Unused option should be selected, this is the factory default setting. The *TCO$_2$M* does not need to be configured to operate with the analog output module. This device simply connects to the rear panel and provides a pass-through for connecting other peripherals to the monitor.

To select an output device:

1. Press and hold the **MENU** key until the DISPLAY menu appears.
2. Press **NEXT** to display the SYSTEM menu.



3. Press ↑ or ↓ (up/down arrows) to select the desired external device type.
4. Press **RUN** to return to the base menu.

NovaCARD

The Novametrix *NovaCARD* Data Archive System allows you to copy patient trend data and parameter values from the *TCO$_2$M* to a personal computer. Once in the computer the data can be printed, analyzed, or made available for other programs. For detailed information on the *NovaCARD* system reference the *NovaCARD* Computer Archive, Recall and Display User's Manual Cat. No. 6066-23.

NovaCARD Configuration

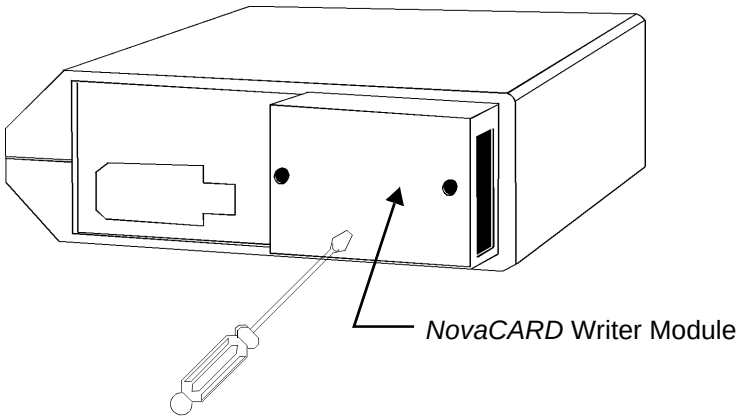
The *NovaCARD* writer module connects to the rear panel output port of the *TCO_2M*. Data from the monitor is downloaded to a memory card which is inserted into the writer module. The memory card is then removed, then inserted into the reader module which downloads the data into the personal computer. Before connecting the Writer Module to the monitor, ensure the *NovaCARD* INTERFACE is selected.

To configure the *TCO_2M* for the *NovaCARD* interface:

1. From the base menu press and hold **MENU** until the DISPLAY menu appears.
2. Press **NEXT** to display the SYSTEM menu.
3. Use the up/down arrow softkeys to select NovaCARD.
4. Press **RUN** to return to the base menu.

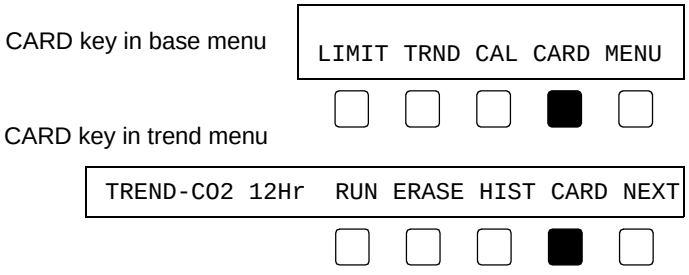
To connect the *NovaCARD* writer module to the *TCO_2M*:

1. Turn the monitor OFF.
2. Fit the module to the RS232C connector on the back of the monitor.
3. To secure the monitor, tighten the two spring loaded screws.



Using NovaCARD

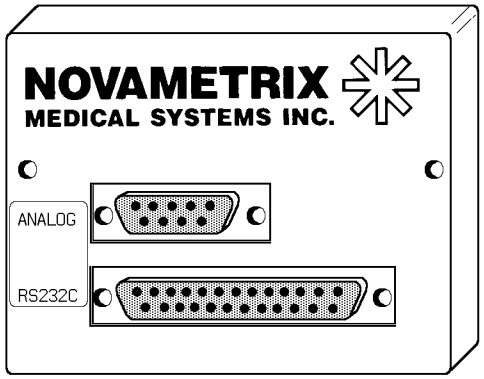
When the *NovaCARD* writer is connected and configured, a **CARD** softkey appears in base menu and the options portion of the Trend Page menu.



To download data into the memory card press the **CARD** softkey when it is displayed. See the *NovaCARD* User's Manual (Cat. No. 6066-23) for detailed information on the operation of the *NovaCARD* system.

Analog Output Module

The *TCO$_2$M* interfaces to analog instruments such as strip chart recorders through the optional Analog Output Module, Cat No. 9622-01. The module provides analog output voltages and an RS232 pass-through port. This allows both analog and serial devices to be used simultaneously.



The Analog Output Module connects to the rear panel connector on the *TCO$_2$M*. An interface cable (Cat. No. 6888-00) is available for connection to a recorder. The cable is supplied with a DB-9 connector on one end, and is open ended at the other for custom tailoring to the user's needs.

The 9-pin analog output connector is described below;

Pin1	O_2 0-250 mmHg, 0.0-1.0V
Pin 2-3	Interface Ground (GNDI)
Pin 4-5	CO_2 0-250 mmHg, 0.0-1.0 V
Pin 8-9	LP -40 to +40 mW, 0.0-0.64 V

The 25-pin RS232C output connector is described below;

Pin 2	RX (Receive In)
Pin 3	TX (Transmit Out)
Pin 6	CTS (Clear to send (input))
Pin 7	GNDI (Interface ground)
Pin 20	DTR (Data Transmit Ready (output))
Pin 21-22	GNDI (Interface ground)
Pin 24-25	VDI (Interface +5 volts)

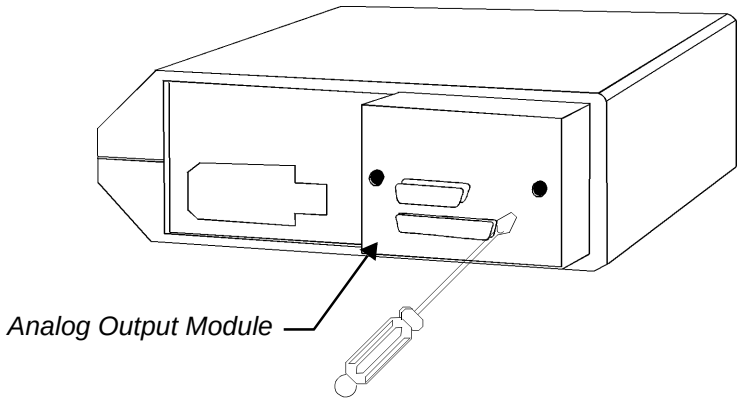
Connecting the Analog Output Module

The *TCO$_2$M* does not need to be configured for the analog output module. Simply connect and secure the module to the monitor's rear panel connector to obtain analog output voltages for $PtcCO_2$ and $PtcO_2$ and LP.

To connect the analog module to the *TCO$_2$M*:

1. Turn the monitor OFF.
2. Fit the module to the RS232C connector on the back of the monitor.

3 Secure the module in place by tightening the two spring loaded screws.



Calibrating an External Recorder

If an external analog recorder is connected to the *TCO_2M* via the analog output option, three calibration voltages can be produced to adjust the recorder for the proper range of output voltages. The *TCO_2M* will produce a zero, half scale, and a full scale DC voltages for each of the analog outputs available.

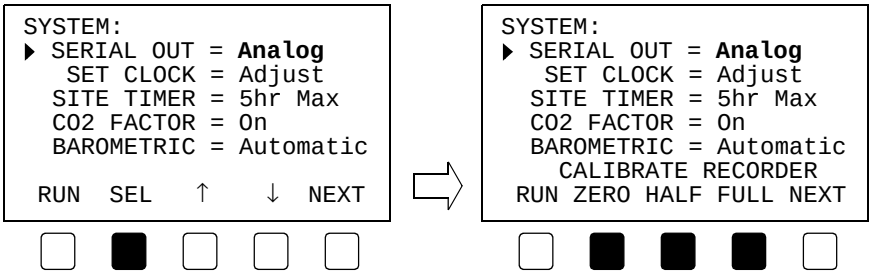
To produce the external recorder scaling voltages:

1 From the base menu press and hold **MENU** until the DISPLAY menu appears.

2 Press the **NEXT** softkey to display the SYSTEM menu.

3 Use the up/down arrow keys to display Analog.

4 Press **SEL**. CALIBRATE RECORDER appears above the softkey options.



5 Press **ZERO**, **HALF**, and **FULL** for corresponding output voltages at the analog output module.

When first selected, the outputs will default to **ZERO**, press **HALF** or **FULL** for the appropriate output scale.

6 Press **RUN** to return to the base menu.

Printer

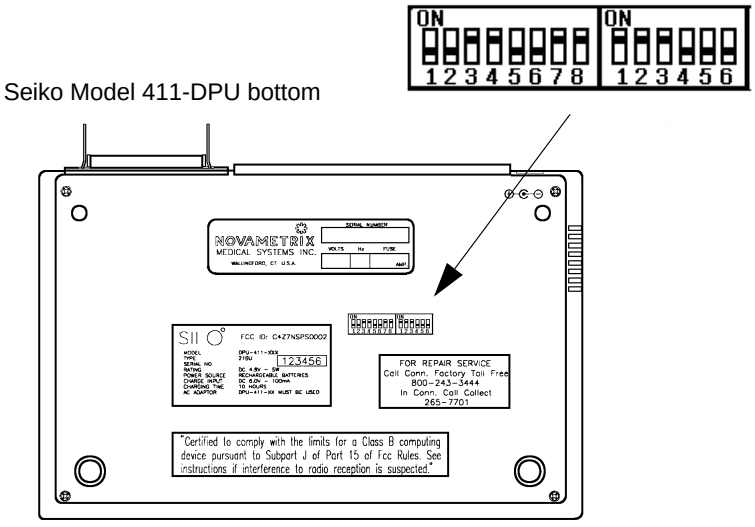
The Seiko DPU-411 thermal printer (Cat. No. 5702-00 for 120 vac, 5703-00 for 220 vac) can be used with the *TCO$_2$M* for trend or tabular printouts. The Seiko DPU-411 printer and the *TCO$_2$M* must each be properly configured before they can operate properly. Interface cable Cat.No. 6887-00 connects the two devices.

Setup Printer

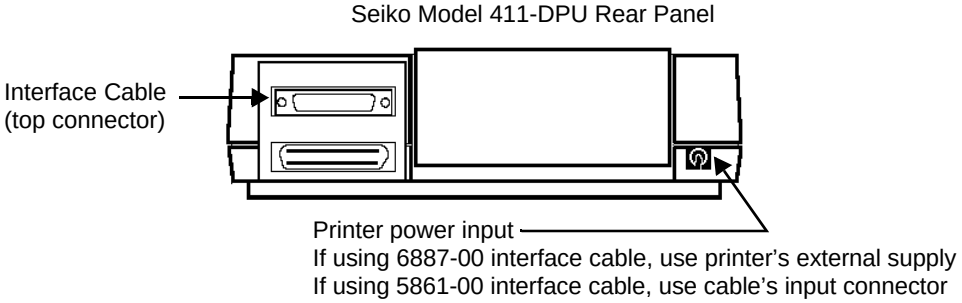
To configure and connect the Seiko DPU-411 thermal printer:

1 Ensure the printer is off.

2 Set the DIP switches on the bottom of the DPU-411 to the proper settings.
First set of eight switches: 1-2 OFF, 3-4 ON, 5-6 OFF, 7-8 ON
Second set of six switches: 1-3 ON, 4-6 OFF.


ON
1 2 3 4 5 6 7 8
ON
1 2 3 4 5 6
Seiko Model 411-DPU bottom
NOVAMETRIX
MEDICAL SYSTEMS INC.
FOR REPAIR SERVICE
Call Conn. Factory Toll Free
800-243-3444
In Conn. Call Collect
265-7701
"Certified to comply with the limits for a Class B computing device pursuant to Subpart J of Part 15 of Fcc Rules. See instructions if interference to radio reception is suspected."

3 Connect a printer interface cable (Cat. Nos. 6887-00 or 5861-00) between the *TCO$_2$M's* RS232 connector and the printer's upper rear panel connector. If using the 6887-00 cable, connect the printer's external power supply to its rear panel and the AC supply. If using the 5861-00 cable, connect the cable's power supply connector to the printer power input connector.


Seiko Model 411-DPU Rear Panel
Interface Cable
(top connector)
Printer power input
If using 6887-00 interface cable, use printer's external supply
If using 5861-00 interface cable, use cable's input connector

4 Turn the printer ON. Refer to the Seiko Model DPU-411 documentation for specific printer operation and maintenance instructions.

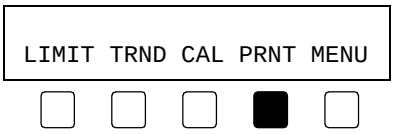
Setup TCO_2M

To configure the *TCO_2M* for the Printer output:

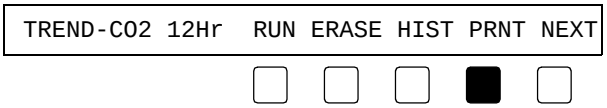
1. Press and hold the **MENU** key until the DISPLAY menu appears.
2. Press the **NEXT** softkey to display the SYSTEM menu.
3. Press ↑ or ↓ (up/down arrows) until Printer is displayed.
4. Press **RUN** to return to the base menu.

   A **PRNT** (print) key appears in the base menu and the options portion of the Trend Page menu.

PRNT key in base menu



PRNT key in trend menu



Types of Printouts

The *TCO_2M* can output data to the printer in several formats.

- Displayed Trend - A printout started from within Full Trend Page Display and recording only the data currently being displayed. Includes graphic and histogram data.
- Compressed Trend - A printout started from the base menu where the entire contents of trend memory are printed out according to a user defined compression setting (to provide better resolution or a shorter printout). Includes both graphic and histogram data.
- Zoom Trend - A printout started from the base menu where a user selected section of trend memory is printed out at maximum resolution. Includes both graphic and histogram data.
- Tabular Real Time - The $PtcO_2$ and $PtcCO_2$ values are printed once every 30 seconds and reflect the monitor's display at the instant of printing. This is the only real-time print mode available.

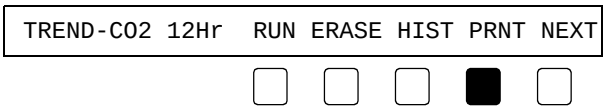
Displayed Trend printout

Displayed Trend Printouts are started from within the Full Trend Page and record the contents of the trend display. For example, if a 12 hour trend is displayed, the printout records those same 12 hours; likewise, if a 30 minute trend is displayed, the printout will show those 30 minutes. The printout contains graphic and histogram data.

To print a Displayed Trend Printout:

1. Display the trend page (press **TRND** then **FULL**) and use the **EXPAND** and cursor keys to display the portion of trend memory to be printed.
2. Press **NEXT** twice and the **PRNT** key appears.
3. Press **PRNT**. PRINTOUT STARTED briefly appears.

Printing starts. It continues until completion or until terminated by the user.



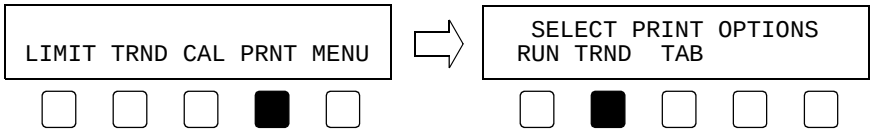
Compressed Trend printout

Compressed Trend printouts, started from the base menu, record the entire contents of trend memory. Printing is based on a user selected compression setting in order to provide better print resolution or a shorter printout. The printout contains graphic and histogram data.

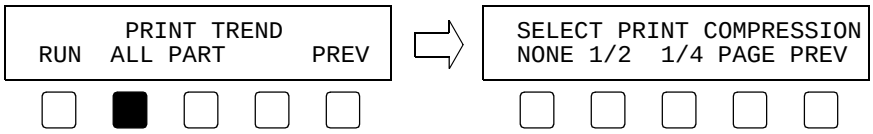
To begin a Compressed Trend (entire trend memory) printout:

1 Press **PRNT** and SELECT PRINT OPTIONS appears.

2 Press **TRND** and PRINT TREND appears.



3 Press **ALL** and SELECT PRINT COMPRESSION appears.



4 From the SELECT PRINT COMPRESSION menu select **NONE**, **1/2**, **1/4** or **PAGE**.

NONE: No time compression (each line is 8 seconds of trend data)
1/2: Each line represents 64 seconds of trend data.
1/4: Each line represents 160 seconds of trend data.
PAGE: Each line represents 320 seconds of trend data.

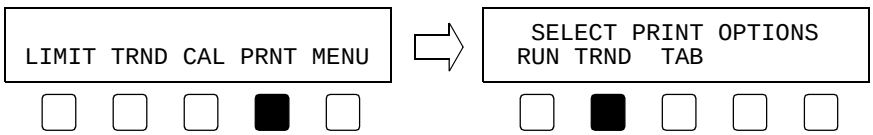
Zoom Trend printout

Zoom Trend printouts, started from the base menu, record a user selected portion of trend memory. Printing occurs at maximum resolution and the printout contains graphic and histogram data.

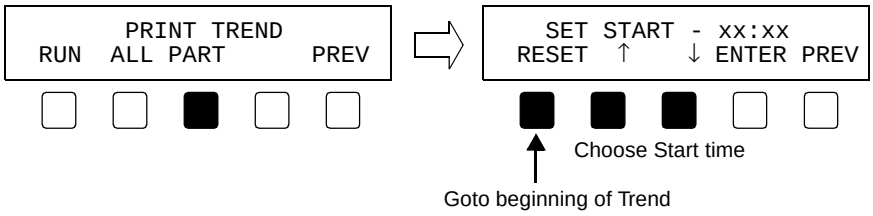
To begin a Zoom Trend (user selected portion of trend memory) printout:

1 Press **PRNT** and SELECT PRINT OPTIONS appears.

2 Press **TRND** and PRINT TREND appears.

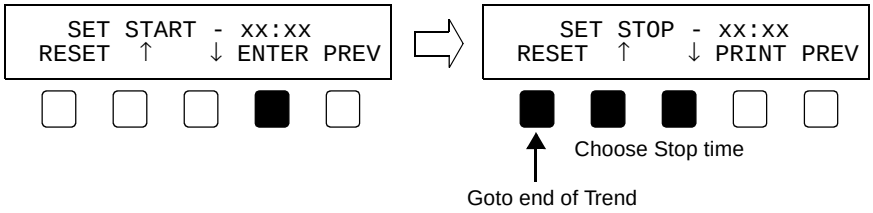


3 Press **PART** and SET START appears.



4 Press **RESET** to display the trend beginning point (oldest data)
- or -
press the ↑ or ↓ (up/down arrows) to select a specific start time.

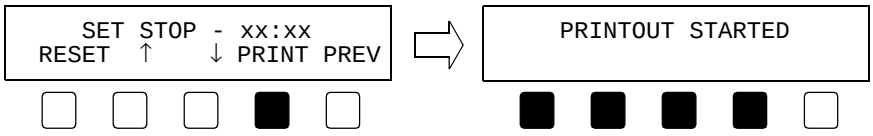
5 Press **ENTER** to accept the displayed start time. SET STOP appears.



6 Press **RESET** to display the trend ending point (newest data)
- or -
press the ↑ or ↓ (up/down arrows) to select a specific stop time.

7 Press **PRINT** to accept the stop time. PRINTOUT STARTED appears briefly.

Printing starts and continues until completed or until terminated by the user



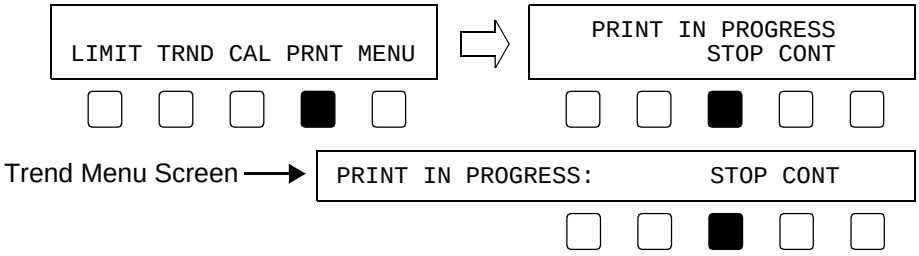
Stopping a printout

Trend printing stops automatically when the selected data is printed; however, you can terminate a trend printout before it completes printing. Tabular Real Time printing continues until the user terminates printing.

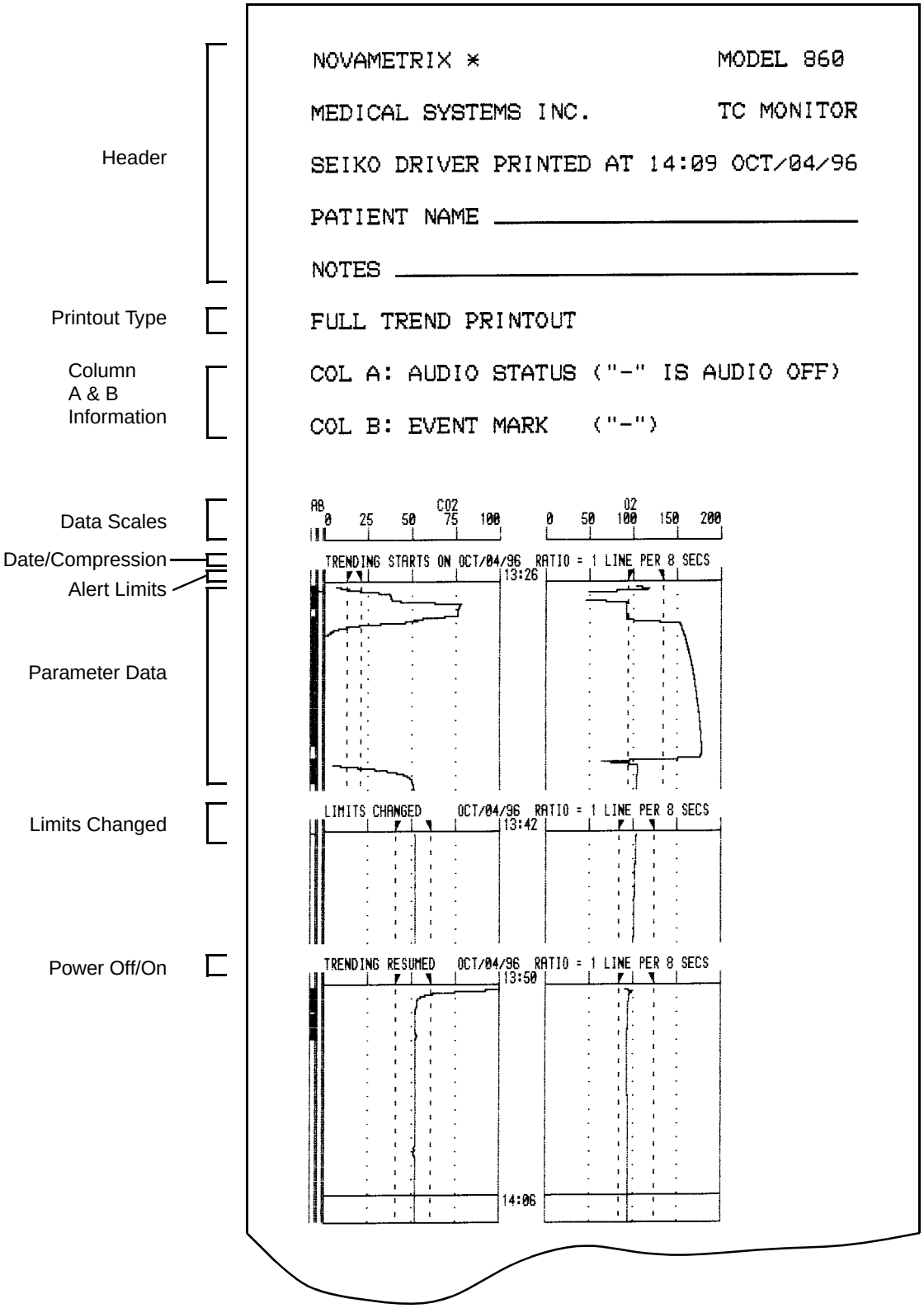
To terminate an active printing job;

1 From the base or trend menu press **PRNT** and PRINT IN PROGRESS appears.

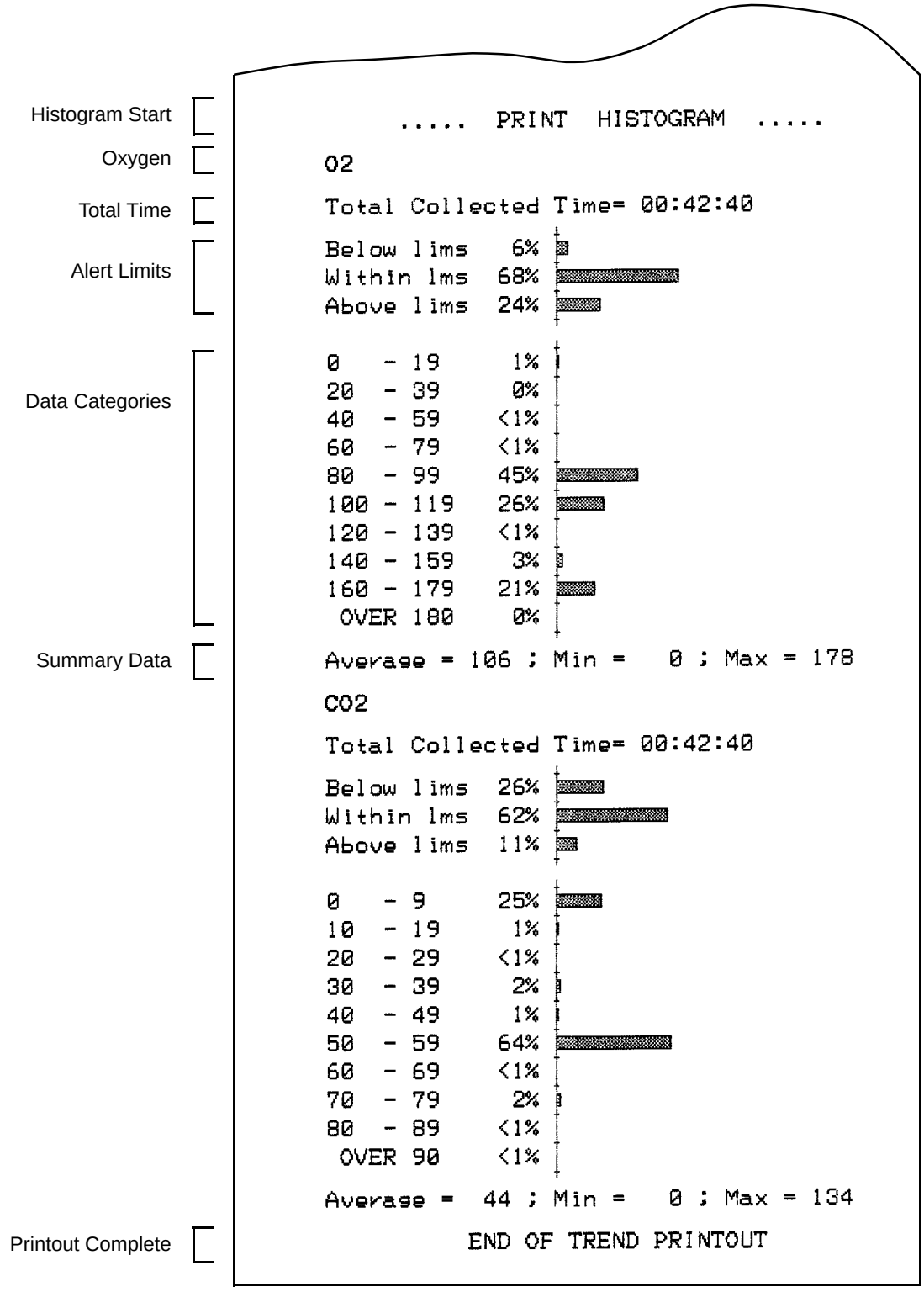
2 Press **STOP**. TERMINATING PRINTOUT briefly appears and printing stops
- or -
press **CONT** (continue) to allow printing to continue.



Trend Printout A sample trend printout is shown below. The printout consists of the several parts.



Sample trend printout continued.


Histogram Start
Oxygen
Total Time
Alert Limits
Data Categories
Summary Data
Printout Complete
..... PRINT HISTOGRAM .....
O2
Total Collected Time= 00:42:40
Below lims 6%
Within lms 68%
Above lims 24%
0 - 19 1%
20 - 39 0%
40 - 59 <1%
60 - 79 <1%
80 - 99 45%
100 - 119 26%
120 - 139 <1%
140 - 159 3%
160 - 179 21%
OVER 180 0%
Average = 106 ; Min = 0 ; Max = 178
CO2
Total Collected Time= 00:42:40
Below lims 26%
Within lms 62%
Above lims 11%
0 - 9 25%
10 - 19 1%
20 - 29 <1%
30 - 39 2%
40 - 49 1%
50 - 59 64%
60 - 69 <1%
70 - 79 2%
80 - 89 <1%
OVER 90 <1%
Average = 44 ; Min = 0 ; Max = 134
END OF TREND PRINTOUT

Header Each printout begins with a header that identifies the monitor as a Model 860 Tc Monitor. The date and time of the printout is furnished by the monitor's calendar/ clock. Space is then provided to enter the patient's name and notes.

Type of printout The trend type (Trend Display, Compressed, or Zoom) is recorded.

Audio Status and Event Marks Column A and Column B refer to the first two column of the graphic trend printout. Column A represents the monitor's audible alert status. A mark (black bar) in this column indicates that the audible alerts were silenced while this data was being collected. Column B shows marks where "Events" were added to the trend memory by the user pressing the [·>|] (Event) key.

Parameter Data Scales The CO_2 and O_2 scales are printed and dotted lines within the data section correspond to the major divisions shown on the scale lines. Data or limits setting outside the scale ranges are clipped at the scale boundries.

Start Date and Compression The date of the first data point is displayed along with the print compression ratio.

Alert Limit Settings Each parameter scale has two triangle shaped markers that represent the upper and lower alert limit setting in effect when the data was collected. Dashed lines extend from these markers down into the data section of the printout. If the alert limits were changed during data collection, the new alert limits will be printed with a message indicating the alert limits were changed.

Data Section The data is graphed based on the selected compression ratio. A time stamp is placed at regular intervals and appears as a horizontal line. A TRENDING RESUMED message shows where the monitor's data collection was interupted when the the monitor was turned off and then later turned back on.

Histogram Printout O_2 and CO_2 histgram data is printed after the graphic trend data.

Total Collected Time Total time represented in the histogram calculations is printed.

Alert Limit Histogram A numerical and graphical display of the percentage of the Total Collected Time each parameter spent below, within, and above the limit values in effect when the data was collected is printed. (Rounding errors may prevent the total fom equaling 100%.)

Histogram Data A numerical and graphical display of the percentage of time spent in each of the ranges listed. Histogram printout is not affected by compression settings. (Rounding errors may prevent the total fom equaling 100%.)

Average, Min and Max The minimum and maximum parameter values are printed. The average refers to the arithmatic mean of all readings.

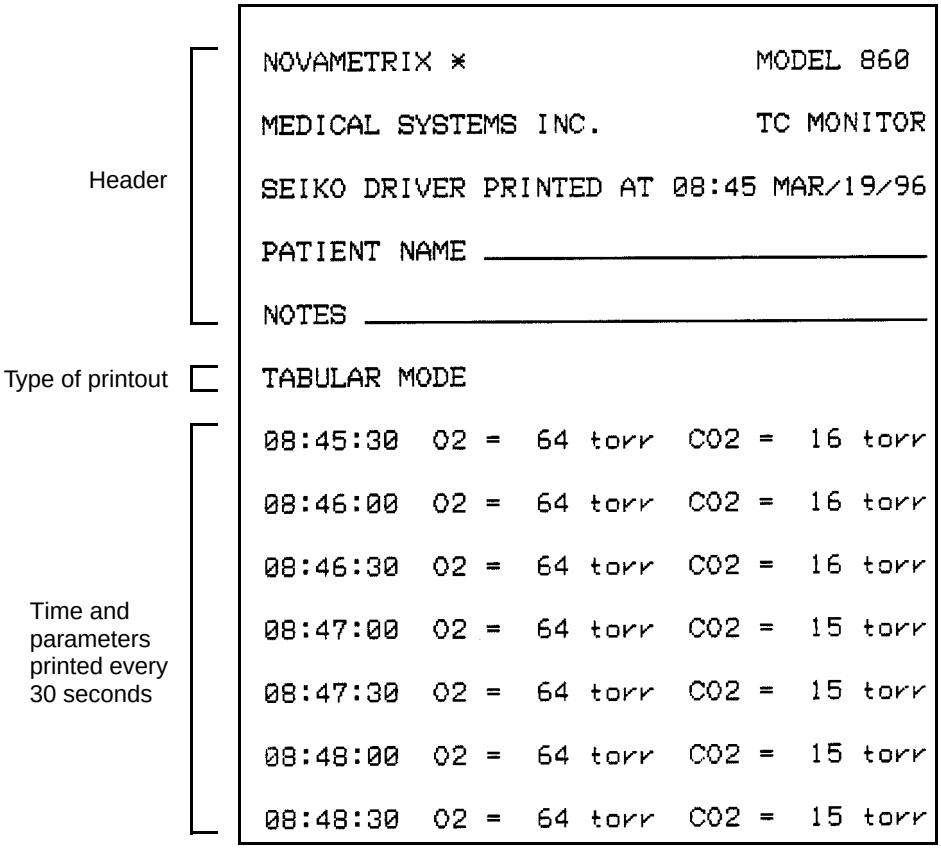
End of Trend Printout This message is printed to show the printout completed sucesfully and all data is present (i.e., the printer did not run out of paper before the printout finished, or that a partt of the printout is not torn away or missing).

Tabular Printout

Tabular mode is a real-time print mode where the $PtcO_2$ and $PtcCO_2$ values are printed once every 30 seconds. The printed values reflect the monitor's display at the instant of printing. (Stored trend cannot be reprinted in tabular mode.)

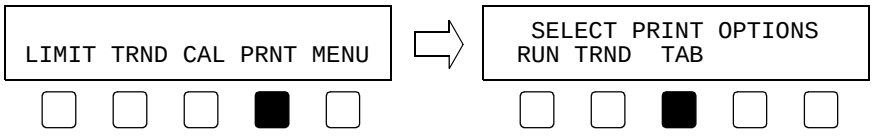
The format for tabular printouts is: "HH:MM:SS O2=XXX UNITS CO2=XXX UNITS"

HH:MM:SS = time in 24 hour format (Hours:Minutes:Seconds)
XXX = displayed parameter value
UNITS = torr (mmHg) or kPa.


Header
Type of printout
Time and parameters printed every 30 seconds
NOVAMETRIX ® MODEL 860
MEDICAL SYSTEMS INC. TC MONITOR
SEIKO DRIVER PRINTED AT 08:45 MAR/19/96
PATIENT NAME
NOTES
TABULAR MODE
08:45:30 O2 = 64 torr CO2 = 16 torr
08:46:00 O2 = 64 torr CO2 = 16 torr
08:46:30 O2 = 64 torr CO2 = 16 torr
08:47:00 O2 = 64 torr CO2 = 15 torr
08:47:30 O2 = 64 torr CO2 = 15 torr
08:48:00 O2 = 64 torr CO2 = 15 torr
08:48:30 O2 = 64 torr CO2 = 15 torr

To begin a Real Time Tabular printout:

1. From the base menu press **PRNT** and SELECT PRINT OPTIONS appears.
2. Press **TAB** (tabular). PRINTOUT STARTED briefly appears.
   Printing starts and continues until terminated by the user.



NovaCOM

The *NovaCOM* interface allows computer access to the monitor's trend data via a cable connection. This interface is designed to output data in formats easily read by a computer or data logging device. This provides the user the ability to "dump" information to a computer file for later analysis. The communications format is 9600 baud, 8 bits, no parity, 1 stop bit and XON/XOFF handshaking.

NovaCOM Configuration

When the *TCO_2M* is configured for *NovaCOM* communication, the connected device (computer or data logging device) must send the appropriate commands to the monitor in order to download the information.

To configure the *TCO_2M* for *NovaCOM1* communication:

1. From the main menu press and hold the **MENU** key until the DISPLAY menu appears.
2. Press the **NEXT** softkey to display the SYSTEM menu.
3. Use the up/down arrow softkeys until NovaCOM is displayed.
4. Press **RUN** to return to the main menu, or **NEXT** to advance to the ALERTS menu.

NovaCOM Data Format

The following sections describe the different commands and responses of the *NovaCOM* interface. Unlike the printer and *NovaCARD* interfaces there will be no new softkey displayed for data transmission. The connected device must request the information before the monitor will transmit the data.

Real Time

In Real Time mode, O_2 and CO_2 values are continually transmitted at one second intervals.

To enter Real Time mode, the computer must send an ASCII "1" character. The monitor will echo back the "1" followed by a <cr><lf>, and enable real time communication.

The data format is: EO***C***Z**<cr><lf>

where:
E - Event Marker identifier, "E"= event marked, "-"= no event,
O - identifier for a 3-digit ASCII O_2 value to follow,
C - identifier for a 3-digit ASCII CO_2 value to follow,
Z - identifier for a 2-digit ASCII calibration status (message) value
*** - a 3-digit ASCII value,
** - a 2-digit ASCII value,
<cr><lf> - a carriage return, line-feed sequence.

The Z** values correspond to the calibration status.

Z** where ** is:	Calibration Status
00	Sensor NOT calibrated
1X	Calibrating Low
21	Calibrating High, Low done
0X	Calibration Complete, Low/High

To exit Real Time mode, the computer must send an “x” or “X” character. The monitor will echo the “x” and then stop real time communication.

Trend Dump

Trend data is transmitted as a succession of records. The record size for *TCO_2M* is 32 bytes of ASCII Hexadecimal data. A record can be one of two types, an INFO record or a DATA record. The INFO record contains monitor information such as time of day, date, limit settings, and units. The DATA record contains event marker, audio disable, CO_2 and O_2 values.

The first record sent is always an INFO record. This record reflects the oldest data in the buffer, then records would continue being sent in chronological order from the oldest record to the newest record. In normal monitoring use, an INFO record would be followed by 15 data records, followed by another INFO record and then another 15 data records, etc. Turning the monitor off, or changing the limits will disrupt this sequence. When this occurs a new INFO record will be sent and indicate the time and date, along with the current limits. At this point, unless another exception occurs, the next INFO record will be followed by 15 DATA records.

An INFO record can be distinguished from a DATA record by the first byte of the record. The first byte of an INFO record is FF, the first byte of a DATA record is 00-C8 (0-200 decimal), or FB (pen lift or no data available). Any other values are not applicable. The DATA record uses 8 data points per parameter, at 8 second resolution, for a total of 64 seconds of trend data per data record.

To request trend dump, the computer must send an ASCII “6” character. The monitor echoes back the “6” character and transmits the first INFO record.

The Mode 6 data format is;

INFO record;

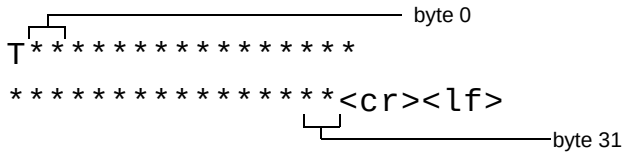
where;
T- Trend mode identifier
**-INFO byte, starting at byte 0 and ending at byte 15 (see below)

byte -0	flag byte = FF for INFO record

byte-1	information type (FE-power on, FD-limit change, FC-time stamp)
byte-2	model code = 03
byte-3	compression ratio = 08 (i.e. 1 point/8 seconds)
byte-4	seconds (0-59)
byte-5	minute (0-59)
byte-6	hour (0-23)
byte-7	day (1-31)
byte-8	month (1-12)
byte-9	year (0-99)
byte-10	O_2 high limit
byte-11	O_2 low limit
byte-12	CO_2 high limit
byte-13	CO_2 low limit
byte-14	units, 00 = mmHg, 01 = kPa
byte-15	Hyperbaric mode = 01 (if 00 = not hyperbaric)
byte 16-31	Not used

<cr> - carriage return
<lf> - line feed

DATA record;



T - Trend mode identifier
**-DATA byte, starting at byte 0 and ending at byte 31 (see below)

byte 0-7	8 byte O_2 data, range: 00-C8 Hex (0-200 decimal) (corresponds to 0-200mmHg, i.e. a value of 64 Hex that corresponds to 100 decimal will indicate an O_2 value of 100mmHg).
byte 8-15	8 byte CO_2 data, range: 00-C8 Hex (0-200 decimal), FB Hex (251 decimal) - no data available over period.
byte 16-23	8 byte Sensor Power data: range 00-C8H (0-200) no Penlifts

byte 24-31	8 byte status data: bit 0 = CO_2 factor 1 = Metabolic factor enabled bit 1-5 = not used bit 6 = mute status 1 = Audio disabled bit 7 = event 1 = Event

<cr> - carriage return
<lf> - line feed

Date and Time

Date and Time mode causes the *TCO$_2$M* to transmit, on request, the date and time as calculated by the monitor's internal calendar clock.

To request the date and time, the computer must send an ASCII "d" character. The monitor echoes back the "d" character and sends the date and time on the same line. The Mode d data format is;

`d•MMM/DD/YY•hh:mm:ss<cr><lf>`

where;
`d` - the echoed command character
`•` - is an ASCII space character
`MMM` - a 3-character month (Jan, Dec),
`DD` - a 2-digit ASCII day (01, 31),
`YY` - the last 2-digits of the year (1990 is 90),
`hh` - a 2-digit hour based on a 24 hour clock (00, 23),
`mm` - a 2-digit minute,
`ss` - a 2-digit second,
`<cr><lf>` is a carriage return, line-feed sequence.

Clear Trends

Clear Trends mode allows the user to remotely clear the *TCO$_2$M* trend memory This action has the same result as the monitor's Clear Trend function in that trend memory and the Trend Page displays are cleared.

Use this remote Clear Trends function with care as there is no way to undo the clear command once issued.

To clear the *TCO$_2$M* trend memory, the computer must send an ASCII "c" character. The *TCO$_2$M* will echo the "c" and then the trend memory will be cleared.

Exit Command

To exit the *NovaCOM* mode, the computer must send an "x" or "X" character. The *TCO$_2$M* will echo the "x" and then stop communication. Sending a new valid command character will start communication again.

Flexport

The *TCO$_2$M* supports a flexport serial interface to the SpaceLabs PCMS monitors. Contact SpaceLabs for flexport information.

To select the SpaceLabs flexport interface;

1. From the base menu press and hold **MENU** until the DISPLAY menu appears.
2. Press the **NEXT** softkey to display the SYSTEM menu.
3. Use the up/down arrow keys to display Flexport.
4. Press **RUN** to return to the base menu.

Terminal

The Terminal option enables the output port to be configured as needed for alternate serial devices. When this option is selected various parameters must be set, these will be sequenced through when the Terminal option is chosen and **SEL** is pressed.

Selecting and configuring the Terminal option:

1. From the main menu press and hold **MENU** until the DISPLAY menu appears.
2. Press the **NEXT** softkey to display the SYSTEM menu.
3. Use the up/down arrow keys to select Terminal. Press **SEL**.
4. When SELECT BAUD RATE appears use the **NEXT** and **PREV** keys to cycle through the available options. Press **SET** when the desired value is displayed.

   The available options are: 1200, 2400, 4800, 9600.
5. When SELECT PARITY appears use the **NEXT** and **PREV** keys to cycle through the available options. Press **SET** when the desired value is displayed.

   The available options are: none, even, odd.
6. When SELECT DATA BITS appears use the **NEXT** and **PREV** keys to cycle through the available options. Press **SET** when the desired value is displayed.

   The available options are: 8, 7.
7. When SELECT STOP BITS appears use the **NEXT** and **PREV** keys to cycle through the available options. Press **SET** when the desired value is displayed. The MONITOR OPTIONS 2 menu will appear.

   The available options are: 1, 2.
8. Press **RUN** to return to the base menu.

14 Maintenance

This section contains the *TCO_2M* and accessory maintenance information.

Cleaning and Disinfecting

Monitor

- Turn the monitor off and unplug the line cord from the AC mains before cleaning.
- The monitor can be cleaned and disinfected with solutions such as isopropyl alcohol 70% solution, 2% glutheralhyde solution, or bleach 10% solution, then wiped with a clean water dampened cloth to rinse and dry before use.
- Do not immerse the monitor.
- Do not attempt to sterilize the monitor.

Sensors

- The sensor should be cleaned with a NOVADISK membrane in place. It can be cleaned and disinfected with solutions such as isopropyl alcohol 70% solution, 2% glutheralhyde solution, or bleach 10% solution, then wiped with a clean water dampened cloth to rinse and dry before use.
- After cleaning, ensure the selected sensor is mechanically sound; with no broken, frayed, or exposed wiring. Ensure that the connector is clean and dry with no signs of contamination or corrosion. Do not use a broken or damaged sensor or one with wet, contaminated or corroded contacts.
- Do not immerse the sensor.
- Do not attempt to sterilize the sensor.
- Refer to the appropriate section of this manual to clean and remembrane the sensor.

Calibrator

- Disconnect the calibrator from the *TCO_2M* if connected before cleaning.
- The calibrator can be cleaned and disinfected with solutions such as isopropyl alcohol 70% solution, 2% glutheralhyde solution, or bleach 10% solution, then wiped with a clean water dampened cloth to rinse and dry before use.
- Do not immerse the calibrator.
- Do not attempt to sterilize the calibrator.

Battery Maintenance

Long Term Storage

If the *TCO$_2$M* has not been used or connected to AC power (AC ON icon ∿ illuminated) for an extended time (e.g., 3 months or more) allow the battery to charge for 12 hours before use.

Charging the battery

To recharge the battery, plug in the line cord and set the rear panel power switch to the (|) ON position. A discharged battery will be fully recharged within 12 hours. The monitor may be operated, on AC power, while the battery is being recharged.

Battery replacement

The internal *TCO$_2$M* battery is not user replaceable. Should replacement become necessary, contact qualified technical service personnel. Replace only with a battery of the same type and rating.

Line Cord

The AC power line cord shipped with monitors for North America is a Hospital Grade, SJT style cord with a 120 VAC plug. All power line cords shipped with monitors for Europe are the European style with a 220-240 VAC plug. All other style power line cords, as required by the country of destination, are provided by the distributor in that country.

Fuses

The rear panel power entry module indicates the AC (line) voltage setting for the monitor. Check that the voltage is correct before attaching the line cord and powering the monitor. The *TCO$_2$M* can be set to operate from 100-120 VAC 50/60Hz or 200-240VAC 50/60Hz.

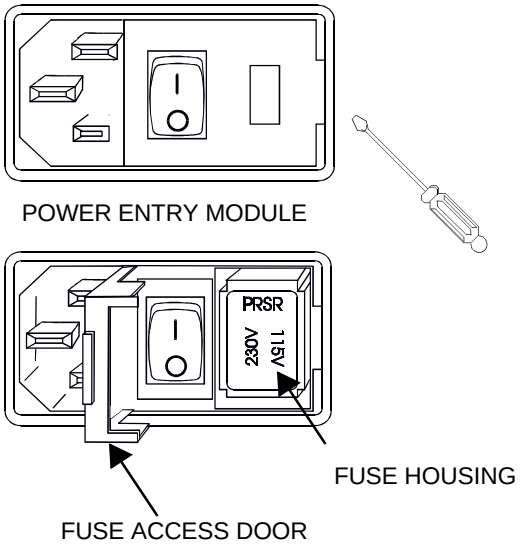
Refer to the following sections for fuse replacement and changing the mains voltage setting.

CAUTION: Replace fuses with same type and rating. Verify proper fuse value for AC voltage setting (see table below).

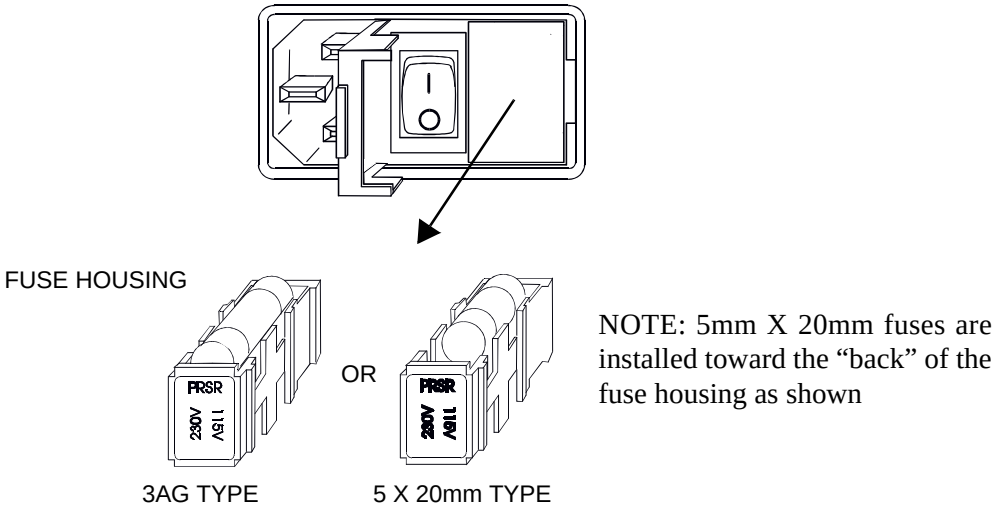
AC Voltage	Fuses (Slo Blo)
100-120 VAC	0.5 A 250V
200-240 VAC	250mA 250V

1. Check that the monitor is OFF.
2. Set the rear panel power entry module switch to OFF (“O”). Remove the line cord from the power entry module (if connected).
3. Using a flat blade screwdriver, pry the fuse access door open to expose the fuse housing.

Note the orientation of the fuse housing (this determines the mains operating voltage).



4 Pry the fuse housing out from the power entry module.

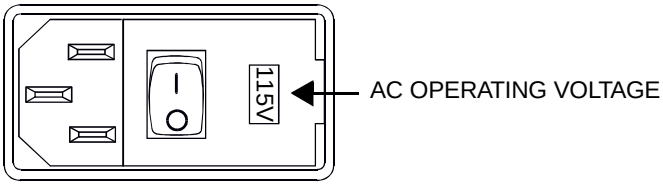


NOTE: 5mm X 20mm fuses are installed toward the “back” of the fuse housing as shown

5 Replace the blown fuse(s) with the proper type and rating.

6 Re-install the fuse housing. When positioning the housing into the power entry module ensure that it is oriented correctly. Press the fuse housing back into the power entry module.

7 Close the fuse access door and verify the proper mains operating voltage is displayed.



15 Specifications

These specifications for the Novametrix *TCO_2M® Transcutaneous CO_2/O_2 Monitor,* Model 860 are listed for informational purposes only, and are subject to change without notice.

Monitor Model 860

Measurement Range	Carbon Dioxide 0-255 mmHg (0-25.5 kPA). Oxygen 0-800 mmHg (0-99.9 kPA).
CO_2 Metabolic Correction	Displayed pCO_2 is compensated for metabolic factors related to the temperature effect and CO_2 production. Refer to "PtcCO2 Display Values" on page 19.
Parameter Alerts	CO_2 and O_2 limit alerts, audible and visible. User selectable, continuously displayed, retained in memory.
Alert Silence	Two minute alert silence with LED indicator. Audio Off with LED indicator (user can disable if needed).
Temperature Section	User selectable 37-45° C in 0.5° C increments. Can be continuously displayed. Audible & visible alarm if actual/set temperatures differ by >0.2° C. Two fully independent thermistors monitor and control temperature. Heater power shutdown with audible & visible alarm at over-temp (45.5° C) or if thermistors differ by >0.5°.
Site Timer	Automatically tracks sensor site duration, provides audible and visible alarms, automatic shutdown of heater power once timer expires. User selectable durations in 0.5 hour increments up to 5, 8, or 12 hour maximum, plus off.
Local Power	The power required to maintain sensor temperature is measured and displayed. Range: 0-800 mW. User selectable power reference point allows for quick power trend analysis (LPR).
Real Time Trends	Continuously displayed user selectable/scalable real time 10, 20, 30 minute trends of CO_2, O_2 or Local Power.
Trend/Histogram Memory	Battery backed 24 hour trends, 8 second resolution. Trend/Histogram displays 30 min, 2, 4, 8, 12 hours.
External Devices	Standard RS232 serial outputs: NovaCARD, computer, printer, others. Optional Analog Module, CO_2, O_2 and LP.

System Power: 100-120/200-240 VAC, 50-60 Hz, 40 VA.
Battery: Greater than 3 hour operation, 12 hour maximum recharge, lead-acid gel-cell.
Display Type: Cold Cathode Display (CCD), 5 × 1.5 inches, W × H (12.7 × 3.8 cm). User adjustable contrast.
Monitor Size: 3.3 × 9.0 × 8.0 inches, H × W × D (8.4 × 22.8 × 20 cm).
Weight: 8 pounds (3.6 kg).
Temperature: Operating 10-40° C (50-104° F), Storage -10-55° C (14-131° F). Relative humidity: 0-90% non-condensing.
Altitude/Pressure: Automatic barometric pressure compensation. Range: 560-800 mmHg (71.9-106.6 kPa).
Safety/Regulatory Approvals: UL/CUL (UL544, CSA No. 125), CSA C22.2 No. 125. TUV Product Service: Tested for compliance to European Safety Standards; IEC 601-1:1988: Amendments 1, 2, EN 60601-1:1990: A1, A2, A11, A12, A13, IEC 601-1-1: 1992: Amendement 1, EN 6060-1-1: 1993, IEC 601-2-23: 1993

EMC Emissions EN55011:1991, Class A. Classification for Radiated and Conducted Emissions

EMC Immunity EN60601-1-2:1993. Collateral standard: Electromagnetic compatibility - requirements and test. Includes; IEC801-2 Electrostatic Discharge Requirements, IEC801-3 Radiated Electromagnetic Fields, IEC801-4 Electrical Fast Transient Burst, IEC801-5 Surge Transients.

Electomagnetic fields up to 3 V/m will not adversely affect system performance.

Sensors

Parameter Combination CO_2/O_2, CO_2 only or O_2 only

Principle of Operation Stow-Severinghaus pH/Clark-type polarographic

Response Time (t_{90}) CO_2 45 sec, O_2 12 sec

Stability Better than 2 mmHg/hr

Diameter/Height 19/11 mm (0.75/0.41 in)

Gas Calibrator Model 868

Calibration System Fully automatic using a true two-point sensor calibration against known gases.

Gas Cylinders Type: PD Contents: 16 liters at 16.5 bar, 21° C (0.6 cu. ft. at 240 psig, 70° F).

Physical Size: 3.3 × 9.0 × 16.5 in., H × W × D
(8.4 × 22.8 × 41.9 cm) includes cylinders.
Weight: 3 lbs (1.4 kg)

Power All calibrator power provided by monitor

17 *Accessories*

Transcutaneous Monitor

6590-00 ***TCO_2M* Transcutaneous CO_2/O_2 Monitor, Model 860**

Combination O_2/CO_2 Sensor

4474-00 **Combination O_2/CO_2 Sensor** for use with Split Membrane NOVADISK

8900-00 **Combination O_2/CO_2 NOVADISK Kit** Pre-Soaked Split Membranes (30 per box)

Gas Calibrator

6633-00 **Transcutaneous Gas Calibrator, Model 868**

8964-00 **Low Point Calibration Gas** (4 cylinders per case)

8965-00 **High Point Calibration Gas** (4 cylinders per case)

Sensor Accessories

8285-00 **Sensor Adhesive Rings** (100 per box)

8805-00 **Sensor Adhesive Rings—Large** (100 per box)

8888-00 **Transcutaneous Sensor Contact Gel** (15 ml bottles, 6 per box)

8353-00 **Contact Medium Applicator** (10 bottles per box)

Carbon Dioxide Sensor

6752-00 **Carbon Dioxide Sensor**

8383-00 **Carbon Dioxide NOVADISK Kit** (24 per box)

Oxygen Sensor

6754-00 **Oxygen Sensor**

8286-00 **Oxygen NOVADISK Kit** (24 per box)

8200-00 **Contact Gel, Transcutaneous Oxygen Sensor** (1 tube, 60 ml)

8231-00 **Zero Oxygen Calibration Solution** (50 vials per box)

Serial/Analog Output & Accessories

5702-00 **Seiko DPU-411 Thermal Printer**, 120 vac (interface cable included)

5703-00 **Seiko DPU-411 Thermal Printer**, 220 vac (interface cable included)

300017 **Seiko DPU-411 Thermal Printer Paper** (5 rolls per box)

6887-00 **Cable** to Seiko DPU-411 Printer

5861-00 **Cable**, Seiko DPU-411 Printer (powers printer from TCO_2M)

5334-00 **Cable**, Serial Output to Personal Computer (25-pin connector)

5335-00 **Cable**, Serial Output to Personal Computer (9-pin connector)

9622-01 **Analog Module** for TCO_2M (includes RS232 pass-thru)

6888-00 **Cable**, Analog Output Module (open ended, 6 ft)

7106-10 **Transport Pouch** (for monitor)

7105-10 **Monitor Accessory Pouch with Printer Support**

7104-10 **Side Accessory Pouch** (included with monitor)

600026 **Power Cord** (included with monitor)

Mounting Systems

140030 **Wall Mount**

140031 **Wall Mount** (less Wall Channel)

140032 **Pivot Block Mount**

140033 **Transport Mount** (without swivel head)

140034 **Transport Mount** (with swivel head)

140035 **Countertop Mount** (11 inch Base)

140036 **Countertop Mount** (5 inch Base)

140037 **Portable Instrument Housing**

Extended Warranty

Warranty Extension: an additional 1 year(s) at time of purchase
(Normal Warranty: Monitor—1 year, Sensor—1 year, Calibrator—1 year)

6590-81 ***TCO_2M* Monitor, Model 860**

6633-81 **Model 868 Gas Calibrator**

6590-82 ***TCO_2M* Monitor & Gas Calibrator & Combination Sensor**

6590-83 ***TCO_2M* Monitor & Gas Calibrator & Single Parameter Sensor**

6590-84 ***TCO_2M* Monitor & Single Parameter Sensor**

6590-85 ***TCO_2M* Monitor & Combination Sensor**

Biomedical Engineering Service Test Kit and Service Manual

Service Test Kits include items and materials qualified service personnel may require to determine the functional integrity and/or accuracy of the system.

6590-90 **(Technical) Service Manual, Model 860**

5435-00 **Service Test kit, *TCO_2M* Transcutaneous Monitor, Model 860**

9999-96 **"focus" Technical Training Seminar** (1 day course)
For class schedules call: 1-800-243-3444 Ext. 2565